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CANADA

DEPARTMENT OF FISHERIES

Fishes Occurring in the Fresh Waters of Insular Newfoundland

by

W. B. SCOTT and E. J. CROSSMAN
Department of Ichthyology and Herpetology
Royal Ontario Museum
University of Toronto
1964

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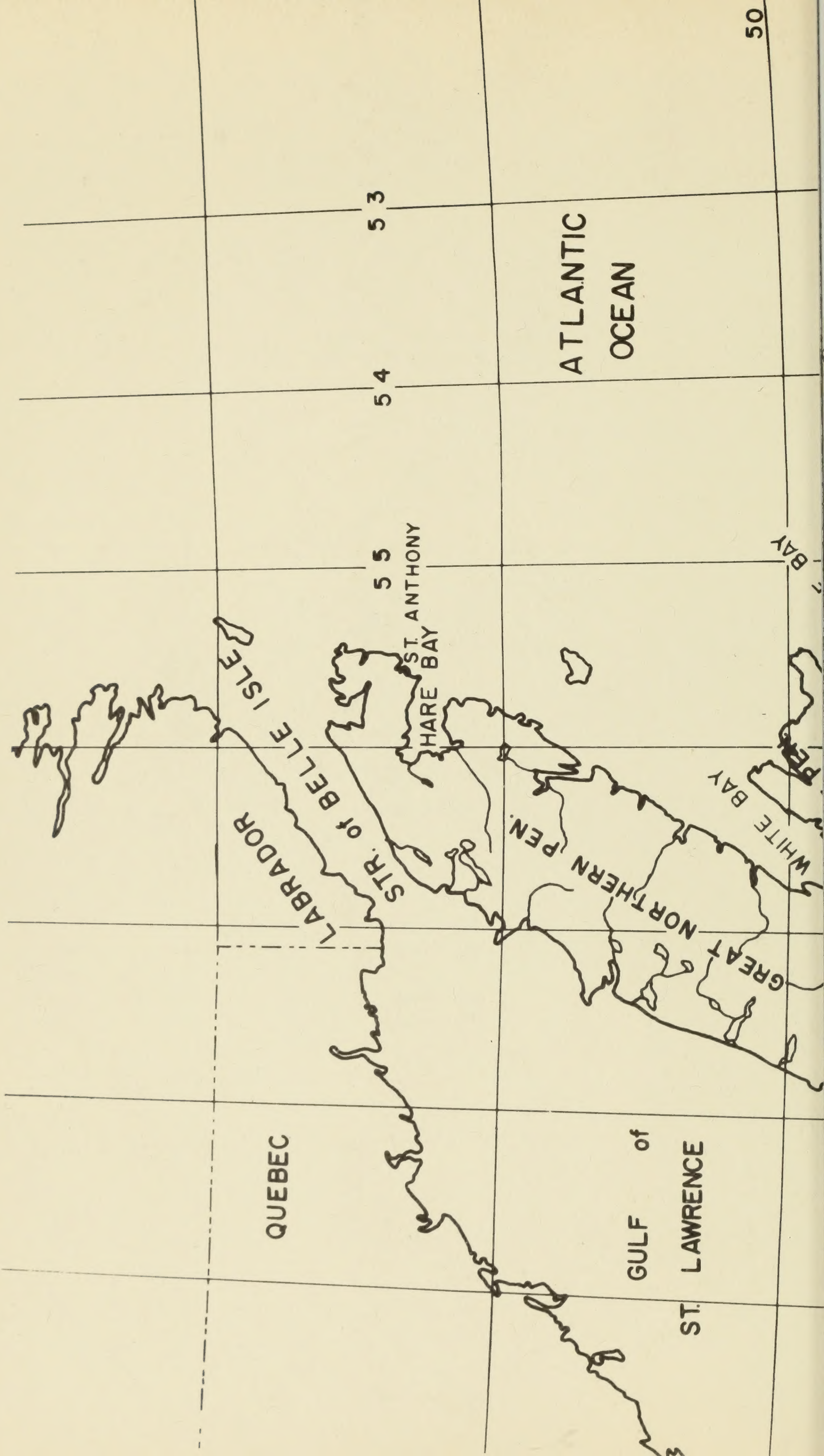
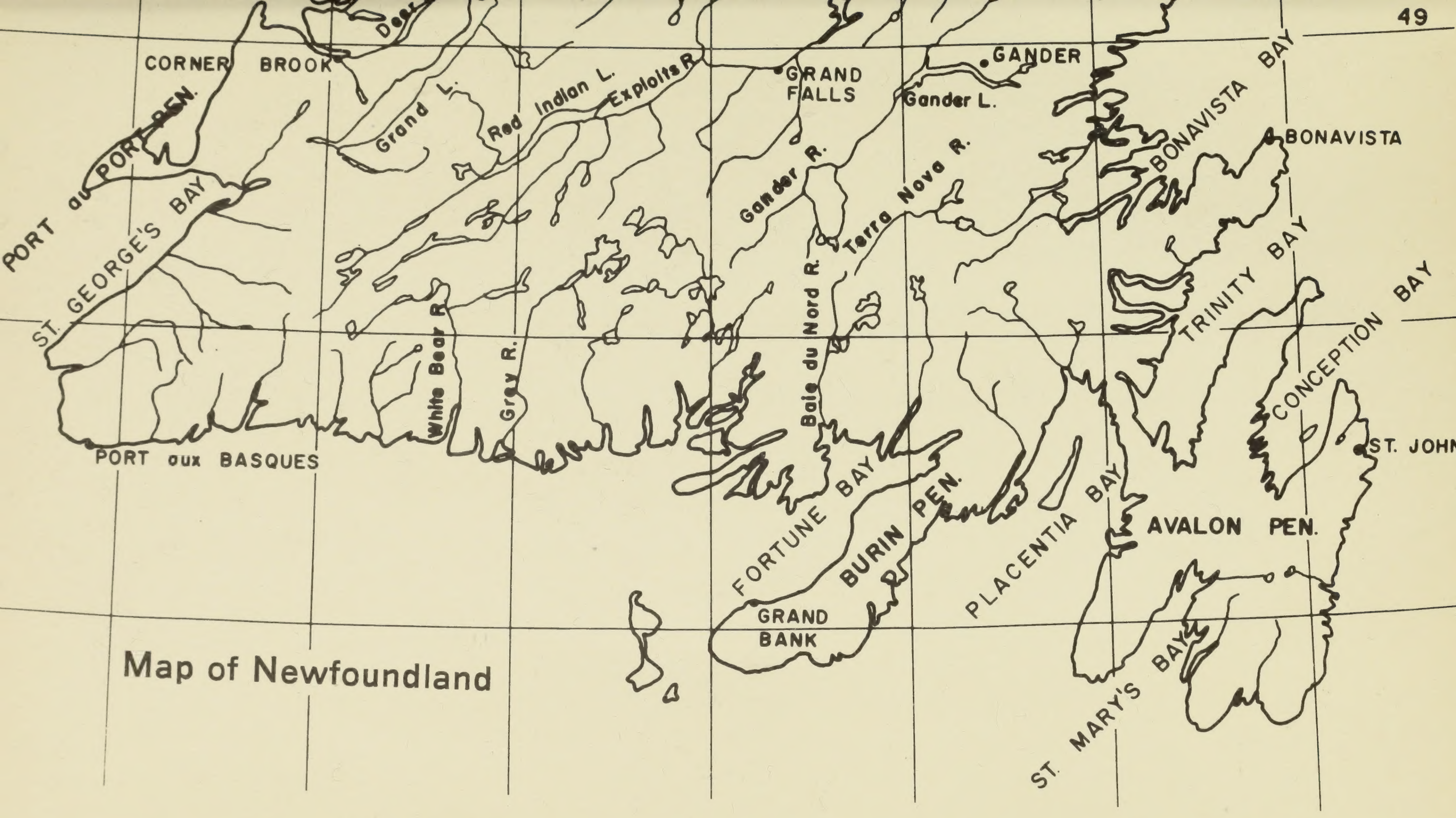


ATLANTIC OCEAN
53
54
55
50
ST. ANTHONY
HARE BAY
STR. of BELLE ISLE
LABRADOR
GREAT NORTHERN PEN.
WHITE BAY
BAY
QUEBEC
GULF of ST. LAWRENCE

RONTISPIECE

Three landlocked Arctic char from a pond on Caplin Cove Brook, Baie Verte Peninsula. Compare with pictures of char from Butt's Pond on page 58. Colour here is quite accurate. Note the absence of white leading edges on the pelvic fins as compared with Butt's Pond specimens. Note also the quite prominent lateral line.

(Photo courtesy of V. R. Taylor.)



Map of Newfoundland

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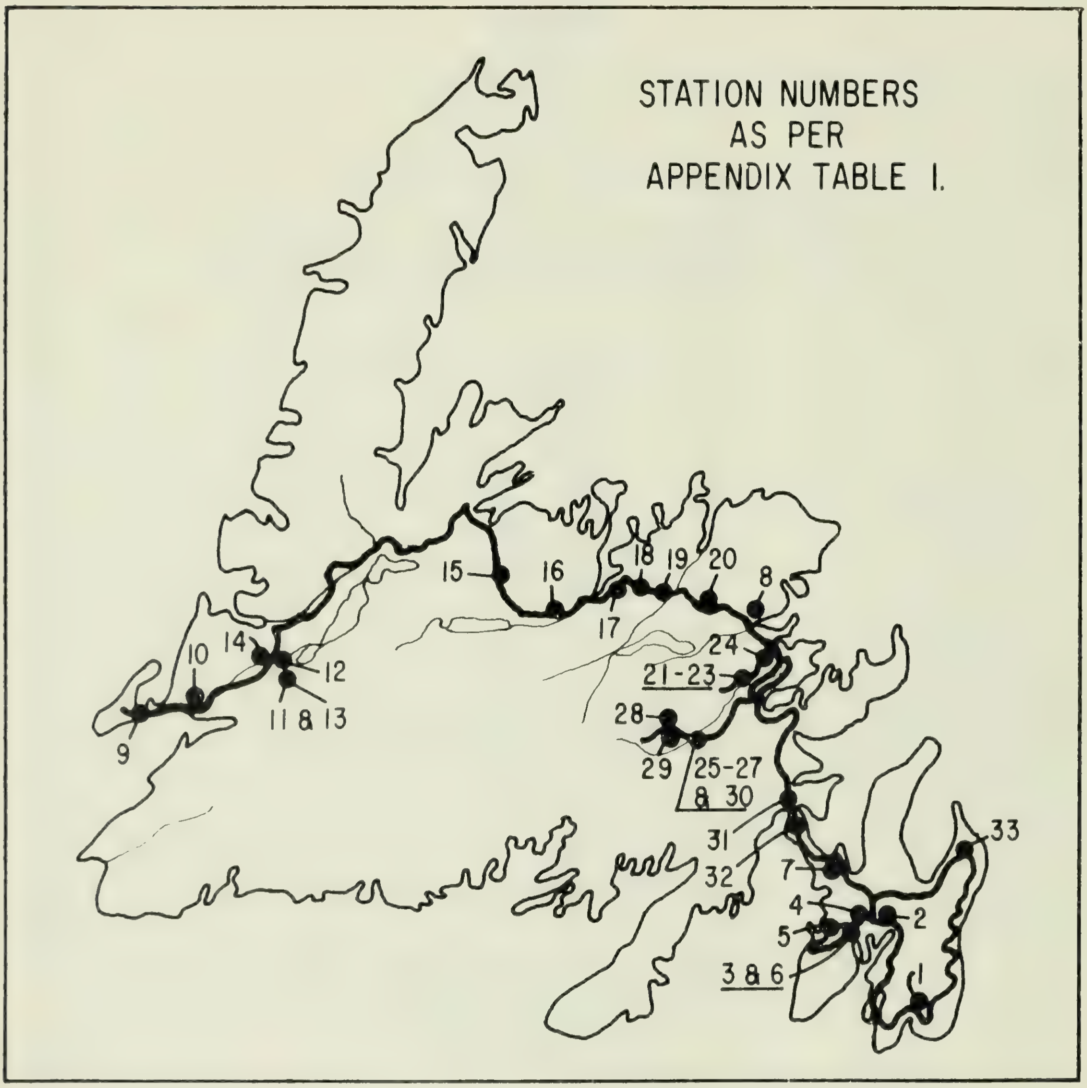

FOREWORD

There is no doubt that since settlement first began on the Island of Newfoundland people have been aware that "trout" and salmon existed in abundance in most inland waters, and there are references in old writings to the facility with which these fish could be taken by angling.

One of the earliest indications that something other than brook trout (locally often referred to as mud trout) might be present, is found in the record of Cormack's journey across the Island of Newfoundland in 1822. Cormack records that the Micmac Indians told him of "a kind of trout", larger than the usual kind, that were to be found in the interior. It seems likely, since these Indians traversed the interior in the course of their hunting and trapping, that this reference was to what we now know as ouananiche (sometimes locally referred to as "winnish"), the freshwater or landlocked salmon. It is known now that many lakes of the interior contain populations of these, some of which grow to quite large sizes.

Toque, writing in 1844, refers to winter trout fishing for *Salmo fario* and *Salmo trutta* (brown trout) and the ease with which large numbers of these could be taken by angling through the ice. There is no doubt that his identification was in error since brown trout are not native to the Island, and were not introduced until 1884 when they were released in ponds near St. John's. It seems likely that the two trout referred to by Toque as *fario* and *trutta* were the two species which now, as then, are commonly found in many parts of the Island, namely the brook trout (*Salvelinus fontinalis*) and the ouananiche or landlocked salmon (*Salmo salar*).

In the early 1880's interest, and perhaps even concern, was being evidenced for the welfare of game fish stocks in freshwater areas. The Crown Lands Act of 1884-1885, Section 19, says "it is enacted that for encouraging the breeding of fish, the right to use ponds, lakes and rivers may be leased together with necessary adjoining land". This Section has had an important effect on the freshwater fish fauna of the Avalon Peninsula, in particular, as it was under this provision that Newfoundland's first and only game fish hatchery was established. As a result, several species of non-native fish were introduced.

Under the Act referred to, a society known as the Game Fish Protection Society was established. The exact date of its establishment is not clear but a report in the St. John's Evening Herald, dated February

23, 1892, advises that the first importation of eggs for public purposes took place in January, 1886. This would indicate that the Society had already been formed and was functioning according to the provisions of the Act of 1884-1885. This account refers to the first importation of eggs *for public purposes* as taking place in January, 1886, but other records fix the likely date of the establishment of the hatchery as 1885, since it is assumed that it would not have been built prior to passage of the Act.

The Game Fish Protection Society subsequently obtained rights to Murray's and Butler's ponds on what is now the Portugal Cove Road and the hatchery was moved to the Murray's Pond location some years later (1895-1897). For rights to the waters of these ponds, the Society paid an annual rental of 10,000 fish fry which they were required to liberate in public waters.

Between 1886 and the early 1900's there were several importations of brown trout, whitefish, salmon trout (=lake trout?), rainbow trout, and smelt. Shortly after 1890 the main effort of the Game Fish Protection Society was evidently directed toward the encouragement of the rainbow trout in local waters.

Dr. C. W. Andrews, who has examined the records of the Game Fish Protection Society, advises that smelt eggs were imported from New York in 1893 and 1895, and planted as forage fishes in some local waters. It is also recorded that sticklebacks were planted for the same reason but it is not clear whether these were imported or collected locally, nor is the species involved known to us.

As a result of these introductions, populations of brown trout (including many sea-run populations) and rainbow trout exist in the waters of the Avalon Peninsula. One population of whitefish is also known to have become established. The Game Fish Protection Society is still active (as the Newfoundland Game Fish Protection Society) and their hatchery remains operative, though it seems that since the early 1900's only rainbow trout have been handled.

The Crown Lands Act of 1884-1885, which made possible the activities of the Game Fish Protection Society, marked the beginning of what might be called "management" activity in the field of freshwater fishes on the Island; although, of course, some regulations were in force prior to that time. Whether or not this was "wise" management is an academic question at this time since the results of these introductions are with us and no doubt will remain.

The next recorded interest in "management" of freshwater areas, other than regulatory, occurred in 1896 when Nielson, Superintendent of Fisheries for the Newfoundland Fishery Commission (established about 1889), suggested the construction of fishways for anadromous salmon on the Terra Nova River and also the introduction of species of Pacific salmon to Newfoundland waters. Evidently no action was taken on either suggestion at the time. Both have been carried out, or attempted, in relatively recent years.

Until the early 1900's, with the exception of the information recorded by Cormack and the reference by Toque, there seem to have been no reliable indications that other than brook trout and sea-run salmon existed in the inland waters of the Island. One of the earliest indications that such might be the case comes from Millais, a naturalist-artist-author-explorer, who made several journeys in the interior of the Island in the early years of the twentieth century and published a book on his travels in 1907. Although Millais was primarily interested in the natural history of the Newfoundland caribou, and perhaps also the acquisition of trophy heads, his observations covered many aspects of the natural history of the country that he travelled. These observations included reference to freshwater fish that he encountered. Millais makes the first reference to ouananiche (landlocked salmon) as such and mentions taking trout, char and ouananiche in many places on his journey.

It is evident from the foregoing that until the beginning of the twentieth century, at least, the fisheries resource of inland waters was almost a complete unknown. There are several reasons for this, not the least being the lack of access to the interior except by water or on foot. No doubt other contributing factors were preoccupation with the sea and the serious business of making a living therefrom. Recreational fishing, the occasional visit to a pond or stream with a pole and can of worms by residents, was not a significant part of the way of life. It remained for railway construction, together with exploitation of the forest resource, to break down, to some degree at least, the lack-of-access barrier.

It was not until 1898 that a trans-island railway was completed to Port aux Basques. The first substantial settlement away from the coast began in 1900 with the establishment of sawmills at Millertown, on Red Indian Lake; and at Glenwood, at the outlet of Gander Lake. At about the same time a sawmill was also established at Terra Nova. These were the first inland establishments though other mills had been established at tidewater since 1890.

With the establishment of these and other mills, the incorporation of the Anglo-Newfoundland Development Company pulp and paper mill in Grand Falls (1905), the beginning of pulp and paper operations at Corner Brook (1925)—subsequently to become Bowaters Newfoundland Pulp and Paper Company, Limited, and the opening of the mine at Buchans (1927), it can be said that the northern half of the interior of the main body of the Island became reasonably accessible. The southern half is to a very large degree still inaccessible except by air, water or on foot. Even with the new access, however, little additional recorded information became available on the fish fauna of the newly accessible areas.

In the Newfoundland Guide Book of 1911, Prowse refers to the success of the hatchery practices carried out by the Game Fish Protection Society earlier and makes reference to Millais who, it says, reported catching brown trout in a pond near Terra Nova. If this report was correct, and it has not been confirmed to date, it would be the first confirmed record of this species off the Avalon Peninsula. The same book also refers to a ". . . white trout, as game as salmon . . ." being taken near Whitebourne. These were probably ouananiche since they are known to exist in that vicinity.

Halkett, in his 1913 *Check list of the fishes of the Dominion of Canada and Newfoundland,* records the presence in Newfoundland of brook trout, the introduced salmonids, ouananiche, and also shad (*Alosa sapidissima*).

Esmonde, describing his fishing experience at Lake St. John, Province of Quebec, refers to the fact that he first met with ouananiche at Indian Lake in Newfoundland (Red Indian Lake).

In 1930 Mr. W. L. Calderwood, a former official of the Scottish Fishery Board, made a brief examination of a few salmon rivers on the Island. A published report on this visit dealt mainly with physical obstructions in some of the rivers and also made reference to wastes from the pulp and paper mill at Grand Falls, Exploits River. Although his study was almost exclusively on sea-run salmon rivers, he also makes reference to ouananiche in Terra Nova Lake. His report recommended remedial action at obstructions in several streams, notably Terra Nova River, Exploits River, S.E. Placentia River, LaManche River and Rocky River near Colinet. Some of these recommendations were acted upon.

Although no attempt is made here to review the history of the investigations of sea-run salmon in Newfoundland, brief mention is made occasionally where it seems to be of special interest. Scientific investigation of this species in Newfoundland may be said to have begun in 1931, and relied almost entirely on sampling of the commercial catch. A 1931 report on this work by Lindsay and Thompson, appended a "First list of fishes in the Newfoundland fishing area".

Frost, writing in the Annual Report of the Fisheries Research Laboratory, 1936-37, stated that "Prior to 1936 no freshwater work had been done other than a few plankton tows. . . In the summer of 1936, however . . . some preliminary work was attempted including a series of plankton tows and a detailed examination of many mud trout. . .". A program of investigations was drawn up (Frost said) to determine such things as life history (for regulatory purposes), best pond and food types and the economy of existing hatchery and restocking methods. These studies were carried out at Murray's and Butler's ponds, near St. John's, and included the collection of various physical and chemical data. Johnson, in the same report, said that studies were also being made of the juvenile stages of sea-run salmon at Salmonier River, St. Mary's Bay.

Marine salmon had by now begun to be recognized as a valuable resource but one that was less productive than in former years. Thus, in 1937, the Province of Quebec established the Quebec Salmon Commission to study the salmon of the Gulf of St. Lawrence in co-operation with the Government of Newfoundland and that of other interested provinces of Canada. To carry out these investigations, study areas were set up in Newfoundland at Port aux Basques, Bay St. George, St. Anthony and Placentia. It seems, however, that most of the effort of this Commission was devoted to tagging studies in the sea. Four reports were published by Belding and Prefontaine from 1938 to 1961 adding considerably to knowledge of the marine migration routes of stocks of salmon in the Gulf.

Studies on purely freshwater species were begun in 1936 by the Fishery Research Laboratory. This, together with the salmon investigations of 1931, mark for Newfoundland what might be called the beginning of scientific investigation into anadromous and freshwater fish stocks, and were reported in the annual reports of their sponsoring organizations. In the case of the freshwater studies, two additional Bulletins were published. The first of the Bulletins was a more or less popular account of the then known species of freshwater fish on the Island. In 1940 a second Bulletin was published providing information on invertebrate food supply, water temperatures, plankton and fish parasites gathered from ponds in the vicinity of St. John's.

There is then somewhat of a gap in freshwater studies, though in 1942 a brief study of pulp and paper mill wastes on the Exploits and Humber rivers was carried out. Some effort was also being extended to the freshwater and marine stages of Atlantic salmon. In the freshwater areas this seems primarily to have been on river obstructions and on the commercial salmon fishery. There has been no significant break in Atlantic salmon studies since that time and much published and unpublished data has been accumulated by the successors to the Newfoundland Fisheries Laboratory and by the Department of Fisheries of Canada, as well as by other organizations.

In 1949 Newfoundland joined the Canadian Confederation and, under the British North America Act, all sea coast and inland fisheries came within the exclusive legislative jurisdiction of the senior government. The Department of Fisheries of Canada, therefore, and its scientific research arm, the Fisheries Research Board of Canada, took over the research and management functions previously assumed by former Departments of the Government of Newfoundland. Under this arrangement, the successor to the former Newfoundland Fisheries Laboratory became responsible for fisheries research and the Department of Fisheries of Canada assumed the major management and administrative functions. An exception was made in the case of purely freshwater fishes, where it was agreed that administration and management of this resource would be undertaken by the new Province.

In 1949 the Newfoundland Department of Natural Resources initiated a brief survey of some of the major freshwater areas on the Island, primarily in the nature of a sampling of their fish populations. The main aim of the survey was to determine species present and whether or not conditions might be suitable for establishment of commercial fishing operations (pers. comm., H. W. Walters). The survey did not indicate that such operations would be feasible. Waters examined included Mobile Big Pond, Hawco's Pond, Gull Pond, Oxley's Pond, Dildo Pond and Ocean Pond—all on the Avalon Peninsula. Also examined were Gander Lake and South Twin Lake in central Newfoundland, and Grand Lake on the West Coast of the Island. The most important information brought out by the survey was perhaps the discovery of landlocked Arctic char (*Salvelinus alpinus*) in several of these waters, as well as the presence of landlocked salmon and landlocked smelts. (The species taken in these waters by this survey are shown in Appendix Table 2 under Collections.)

In 1951 the St. John's Biological Station of the Fisheries Research Board of Canada began an investigation of the major salmon rivers of the Island. These investigations, which emphasized enumeration of adult and juvenile runs of anadromous salmon, also included investigation of upstream areas of the rivers involved and sampling in lakes and ponds. As a result, additional information on freshwater fishes was made available. These studies began with the Gander River. Examination of Gander Lake and Gander River, as part of this study, revealed the presence of landlocked Arctic char and landlocked smelt.

Surveys of the Terra Nova River System and the Bay du Nord River were carried out in 1952 and 1953. Investigations of the Little Codroy River began in 1953 and studies there have continued to the present time. After Confederation with Canada, research activity into the fishery resource became a function of the Fisheries Research Board of Canada and resource administration and management a responsibility of the Department of Fisheries proper. Thus the Department's Conservation and Development Service assumed such "management" activity as fishway construction as well as routine protection and regulation enforcement. These functions were carried out by the Protection Branch of the Conservation and Development Service until 1954 when the nucleus of a Fish Culture Development Branch was established.

While the Protection Branch is, primarily, an enforcement arm of the Service, the Fish Culture Development Branch (staffed by biologists, engineers and technicians) is an investigative arm designed to deal with *ad hoc* problems affecting the resource and to recommend remedial and development measures based on the best information available from research sources. The Fish Culture Branch (in Newfoundland) concerns itself primarily with the freshwater phase of anadromous fishes as well as with purely freshwater fishes. This latter function was not assumed until 1956 when, by agreement between the two governments, management and investigation of freshwater species was relinquished by the Provincial Government and assumed by the Department of Fisheries of Canada.

Because the Fish Culture Development Branch in 1956 was still in its formative stages, and because of the necessity to emphasize matters relating to anadromous salmon, it was unable to do other than very sporadic work in the field of purely freshwater fishes—usually incidental to the main program on Atlantic salmon. Thus in 1955, while doing a survey of obstructions to salmon in the Humber River, it was possible to "sound" Adies Lake and Deer Lake. Adies Lake, it was found, though local report had it "bottomless", had a maximum depth of some 48 feet. It was also determined to have a good population of brook trout but no other species (i.e. other than sea-run salmon) were located. Deer Lake, a much larger body of water, was sounded though not in great detail. The deepest water located was in the order of 325 feet. No population sampling was carried out on either lake, except by angling.

Because of the lack of information on inland waters, and because Departmental staff could not be seconded to lake work, it was decided in 1959 to request personnel of the Department of Ichthyology and Herpetology of the Royal Ontario Museum to make a brief survey of the species present in freshwater areas of the Island. This was done and Drs. Scott and Crossman carried out an investigation during July 1960. It is as a result of that survey that the report to follow has been written. This survey extended significantly knowledge of the species in freshwater and estuarine areas as is brought out in the main report.

Beginning in 1961, and continued in 1962, it was possible for the Department of Fisheries in the Newfoundland area to begin initial study of major freshwater areas and their fish populations. By the end of 1962 ten representative lakes had received preliminary examination, primarily in the nature of collecting morphometric data and sampling of fish populations. Lesser amounts of other limnological data were also collected. Although much information gathered during these surveys has not yet been analysed or reported on, it can be generally said that most large lakes probably have a relatively low productive capacity—somewhat similar perhaps to lakes of equivalent size in the northern part of the Prairie Provinces. The largest lakes examined (Gander Lake, Red Indian Lake and Deer Lake) are generally quite deep (e.g. maximum depth, Red Indian Lake—485 feet; Deer Lake—325 feet; and Gander Lake—875 feet). On the biological side it was confirmed that almost all lakes examined contained, besides fair to good populations of brook trout, well established populations of ouananiche and frequently landlocked smelt. Landlocked Arctic char were also located in waters from which they had not previously been reported. Of less significance, but of interest, the tomcod (*Microgadus tomcod*) was reported from an inland area for the first time (Deer Lake, Humber River).

The foregoing paragraphs bring us to the present time. Perhaps one of the most significant things brought out in these is that, for all of its long history, there is still much to be learned about the fresh-water areas of the Island of Newfoundland and their fish populations. It is only in recent times that the existing and potential value of this resource has begun to be realized. This, of course, is the reason for the interest in it now—to make possible wise exploitation of what exists and, where feasible, to develop its productive capacity to even higher levels.

V. R. TAYLOR, *Chief,*
Fish Culture Development Branch,
Department of Fisheries of Canada,
St. John's, Newfoundland.
November 1962.

INTRODUCTION

Insular Newfoundland is located between the 47th and 52nd parallels of north latitude. With an area of 42,734 square miles, it lies in the Gulf of St. Lawrence, its western shores washed by Gulf waters and those on the north, east and south by the Atlantic Ocean.

The following account of the fishes of Newfoundland deals only with the insular or island portion of that province, exclusive of the continental or Labrador portion.

The Canadian freshwater fish fauna, while admittedly sparse (less than 200 species) because of relatively recent extensive glaciation and its northerly position, is nevertheless poorly known. All too few of Canada's numerous lakes and rivers have been surveyed for knowledge of the fish populations and for general limnological information. This is particularly true of Newfoundland. Although not much has been written about the fishes in the freshwaters of the island, enough evidence had accumulated to suggest that the island had a significant fauna. In most early publications dealing with Canadian fishes, Newfoundland was included in the coverage but its fauna was not described. Halkett (1913), in his introduction to the *Check list of the fishes of the Dominion of Canada and Newfoundland,* wrote as follows: "The list of fishes, especially the freshwater fishes, of Newfoundland, is admitted to be inadequate. There appears to be no published records of the species of that colony (save a list of *The fishes of Labrador,* by William Converse Kendall), yet as one third of the island of Newfoundland is covered with water some interesting finds may in the future be looked for."

Halkett wrote half a century ago but the words might easily have been written in 1960 with equal truth.

Although Newfoundland was colonized before any other part of Canada or indeed North America, the fishes that occur in its freshwaters are little known except for the Atlantic salmon and the speckled trout. No comprehensive collection of fishes from rivers, ponds and lakes has ever been made and hence there are few specimens available for study.

The present work, involving as it does the study of over 3,000 specimens from more than 50 localities, has yielded some very useful and interesting information but is preliminary in nature. It is hoped, however, that its obvious deficiencies will spur others to gather material from the many Newfoundland lakes and estuaries as yet inaccessible except by water or air.

It was this hope of stimulating further work as well as a feeling that a report of this nature would be of use to Fishery Officers, anglers and other interested parties that led the Department of Fisheries to ask that it be prepared.

The style and content are intended to fulfil two main purposes. More complete biological or life history information is supplied for all sport fishes for the benefit of those interested. At times data from other areas from the literature was added for completeness and comparison. Systematic data where available is included and discussed in the light of geographic variation. For some species these data are meager but are included since this information appears nowhere else.

For many, the salmonid keys will seem too dependent on colour. It should be kept in mind that these keys were intended for use in the field with living or freshly killed fishes and wherever possible characters based on detailed measurements or microscopic examination were avoided.

MATERIALS

In 1960 the authors spent the month of July collecting by the use of seine and gill net in numerous lakes, streams and estuaries from the Avalon Peninsula on the east to the Port au Port Bay region in western Newfoundland. During this period a total of 23 species were recorded and 3,100 specimens collected. The route travelled and the site of each collection are shown in the map on page IV.

Mr. V. R. Taylor also made available specimens and data retained in the laboratory of the Department of Fisheries in St. John's.

Mr. A. Murray, on the staff of the Fisheries Research Board of Canada, Biological Station, St. John's, very kindly forwarded to the Royal Ontario Museum a collection of fishes gathered in 1961 in the Little Codroy River near St. Andrews, Port aux Basques region of southwestern Newfoundland.

Also available was a small collection of fishes gathered under the auspices of the Newfoundland Department of Natural Resources in the winter of 1949-1950 by Dr. A. A. Blair, Fisheries Research Board of Canada, and Dr. A. O. Blackhurst. This collection was received by the Royal Ontario Museum in 1950 (see App. Table 2).

The National Museum of Canada and the United States National Museum kindly loaned Newfoundland specimens for study.

ACKNOWLEDGMENTS

The following account was made possible by the Conservation and Development Service of the Department of Fisheries of Canada and we are particularly grateful to the Director of the Service, Dr. A.

L. Pritchard. Mr. V. R. Taylor, Chief, Fish Culture Development Branch of the Department of Fisheries of Canada for Newfoundland, generously provided transportation, field equipment and laboratory space, and assisted in many ways too numerous to mention. His sincere interest and kindly advice was of immeasurable help in our wanderings through many delightful but remote areas of inland Newfoundland. Many other of the Department's personnel were very helpful, supplied information and shared their accommodations with us. Chief among these were Mr. George Fury, Mr. Roy Lane, Mr. Jerry Best and Mr. Bill Davis.

Dr. C. L. Belcourt of Ferryland took in two wandering strangers in an area not notable for its variety of transients' accommodation, and was most gracious in his hospitality.

The Ernest Harmon U.S. Air Force Base camp at Grand Lake very kindly provided accommodations while we were in that area and M/Sgt. Ken Nordin was of considerable help.

Access to many areas was only possible through the co-operation of Bowaters Pulp and Paper and the Anglo-Newfoundland Development Company. Special thanks go to Mr. Whitehorne of A.N.D. who kindly provided accommodation and a boat at Lake St. John. Mr. Lou Parsons, also of A.N.D., who operated the boat, not only helped but made our short stay on the Terra Nova River memorable.

Many of our colleagues assisted most generously—Dr. Geoff Power, Waterloo University, read the scales of *Salmo salar* and worked up the growth data for that species; Mrs. Jermolajev, through the help of Mr. K. H. Loftus of the Ontario Department of Lands and Forests, read the scales of *Salvelinus fontinalis* and *S. alpinus* and provided the growth analysis for these species. Dr. F. D. McCracken, Fisheries Research Board of Canada, and Dr. J. D. McPhail, generously made available original data. Dr. C. W. Andrews of Memorial University, long associated with and interested in fisheries work in Newfoundland, provided helpful information on rainbow trout. Dr. F. A. Aldrich, also of Memorial, allowed us to examine a specimen of *Fundulus diaphanus* recently taken in Noel's Pond.

Much help was received in the preparation of the paper and this is gratefully acknowledged. Various members of the staff of the Department of Fisheries, St. John's, the Fisheries Research Board, St. John's, and the Royal Ontario Museum helped with illustrative material. Mr. W. H. Carrick prepared the species photographs. Photographs of Newfoundland scenes were taken by authors except where noted. Mr. Peter Buerschaper of our Department ably assisted by carefully compiling morphological data. Miss Sandra Faulkner, Department Secretary, cheerfully worked long and patiently at the many revisions of the manuscript.

LIST OF FISHES OCCURRING IN FRESHWATERS OF NEWFOUNDLAND

1. Petromyzon marinus Linnaeus 1758 — sea lamprey
2. Acipenser oxyrhynchus Mitchill 1815 — Atlantic sturgeon
3. Alosa pseudoharengus (Wilson) 1811 — alewife
4. Alosa sapidissima (Wilson) 1811 — American shad
5. *Coregonus clupeaformis (Mitchill) 1818 — lake whitefish
6. *Oncorhynchus gorbuscha (Walbaum) 1792 — pink salmon
7. *Salmo gairdneri Richardson 1836 — rainbow trout
8. Salmo salar Linnaeus 1758 — Atlantic salmon
9. *Salmo trutta Linnaeus 1758 — brown trout
10. Salvelinus alpinus (Linnaeus) 1758 — Arctic char
11. Salvelinus fontinalis (Mitchill) 1815 — brook trout
12. Osmerus mordax (Mitchill) 1815 — American smelt
13. Anguilla rostrata (LeSueur) 1817 — American eel
14. Fundulus diaphanus (LeSueur) 1817 — banded killifish
15. Fundulus heteroclitus (Linnaeus) 1766 — mummichog
16. Microgadus tomcod (Walbaum) 1792 — tomcod
17. Apeltes quadracus (Mitchill) 1815 — fourspine stickleback
18. Gasterosteus aculeatus Linnaeus 1758 — threespine stickleback
19. Gasterosteus wheatlandi Putnam 1867 — twospine stickleback
20. Pungitius pungitius (Linnaeus) 1758 — ninespine stickleback
21. Ammodytes americanus DeKay 1842 — American sand lance
22. Scophthalmus aquosus (Mitchill) 1815 — windowpane
23. Pseudopleuronectes americanus (Walbaum) 1792 — winter flounder

* Introduced species.

KEY TO THE IDENTITY OF FISHES FOUND IN FRESHWATERS OF INSULAR NEWFOUNDLAND

This key is primarily intended as a means of identifying living or freshly killed fishes in the field. Characters requiring detailed measurements and microscopic examination have, where possible, been avoided. Photos and more detailed morphological descriptions in the discussion of each species will help separate difficult or closely related forms.

1 Body cylindrical, long and snake-like; no visible scales; caudal fin rounded or pointed not forked; dorsal, caudal and anal fins united (first dorsal separate in lamprey) 2
Body not as above 3

2 No true jaws; mouth with circular, suctorial disc; no paired fins; 7 gill openings on each side.
SEA LAMPREY *Petromyzon marinus*
With true jaws and horizontal mouth; paired pectoral fins present; 1 gill opening on each side.
AMERICAN EEL *Anguilla rostrata*

3 Upper lobe of tail much longer than lower; body with a few rows of bony plates rather than scales; 4 barbels on underside of snout ahead of the round mouth.
ATLANTIC STURGEON *Acipenser oxyrhynchus*
Lobes of tail equal and forked, rounded or square; body with scales; mouth not round; single, soft-rayed, dorsal and anal fins ... 4

4 With adipose fin and scales 5
Without adipose fin but with scales 7

5 With large recurved apical tooth on tongue; no coloured or black spots on body; no fleshy appendage at base of pelvic fins.
AMERICAN SMELT *Osmerus mordax*
No tooth on apex of tongue; fleshy lobe or flap present at base of pelvic fins 6

6 Body silvery to golden; sides without coloured or black spots; mouth toothless and subterminal behind rounded snout; tail forked.
LAKE WHITEFISH *Coregonus clupeaformis*
Body silvery or brightly coloured, with coloured or black spots prominent; mouth terminal and toothed; tail forked or square.
SALMONS and TROUT—Salmonidae .... see separate keys

7 Single, rayed, soft dorsal fin and a single anal fin; no chin barbel 8

With 3 dorsal fins, 2 anal fins and a single median barbel on tip of lower jaw.

TOMCOD *Microgadus tomcod*

8 Rayed soft dorsal fin short, no more than 15 rays 9

One dorsal fin with over 50 rays 13

9 Soft dorsal fin preceded by 2 to 12 isolated (not connected by membrane) sharp spines; anal fin with 1 spine and less than 15 rays; pectoral fin with sharp spine; small fishes, do not exceed 4 inches.

STICKLEBACKS—Gasterosteidae .... see separate key

No spines preceding soft dorsal fin; no spine in anal or pectoral fins; pelvics with fleshy lobe at base 10

10 Caudal fin deeply forked; anal fin longer than and far behind dorsal and with more than 15 rays; ventral surface between head and pelvic fins knife-edged and saw-toothed; (herring, *Clupea harengus,* has no sharp scuted scales in this area and belly is rounded); larger fishes, may exceed 15 inches; shad and alewife 12

Caudal fin rounded or square; anal under dorsal; anal and dorsal nearly of same size and rounded; anal with less than 15 rays; ventral surface scaled but smooth; small fish, not over 6 inches.

KILLIFISHES—*Fundulus* 11

11 Distance from origin of dorsal fin to end of vertebral column stepped *forward* from origin of dorsal fin reaches the middle of the eye; gill rakers usually 5 widely spaced and obvious.

BANDED KILLIFISH *Fundulus diaphanus*

Distance from origin of dorsal fin to end of vertebral column stepped *forward* from origin of dorsal fin reaches the posterior half of the operculum; gill rakers 9 or more, crowded and not obvious.

MUMMICHOG *Fundulus heteroclitus*

12 Lower jaw and upper jaw equal when mouth closed, lower jaw fitting into notch in upper; in specimens over 12 inches two alar scales (specialized flap-like scales joined to the fin along one edge) on each side of the caudal fin, one on each lobe of the fin; maxillary extending at least to posterior margin of eye.

AMERICAN SHAD *Alosa sapadissima*

Lower jaw extending beyond upper jaw when mouth closed; no alar scales on tail; maxillary extending just to mid point of eye.

ALEWIFE *Alosa pseudoharengus*

13 Body flat, somewhat oval; width many times greater than thickness; underside white; both eyes on one side; anal fin with over 40 rays; caudal rounded.

FLATFISHES 14

Body slender, cylindrical, upright; depth no more than twice thickness; snout pointed; eyes one on each side; anal fin with fewer than 40 rays; caudal forked.

AMERICAN SAND LANCE *Ammodytes americanus*

14 Both eyes on right side; lateral line only slightly arched; general colour dark with dark inconspicuous blotches.

WINTER FLOUNDER *Pseudopleuronectes americanus*

Both eyes on left side; lateral line greatly arched; general colour lighter brown with prominent black spots.

WINDOWPANE *Scophthalmus aquosus*

An aerial view of "pond" country in North Central Newfoundland. The forest area is mostly black spruce and balsam fir.

Sea lamprey *Petromyzon marinus* Linnaeus 1758

The sea lamprey has apparently never been caught in any Newfoundland lake or river, at least there are no literature reports of such captures. Bigelow and Schroeder (1948) received a report, via Dr. A. A. Blair, of a "specimen taken 1½ miles off the Newfoundland coast near St. John (found attached to the bottom of a fishing boat) in November 1946." The same authors report a specimen in the U.S. National Museum taken on the Grand Banks south of Newfoundland.

The present authors have on hand an unconfirmed report of a spawning run of sea lamprey in Trepassey Brook, Avalon Peninsula.

Atlantic sturgeon *Acipenser oxyrhynchus* Mitchill 1814

There are few records of occurrence for the sturgeon in Newfoundland waters and none apparently from freshwater.

The most northerly record off the Atlantic coast of North America would seem to be Backus' (1951) report of a specimen taken "July 31, 1950, in Hamilton Inlet near Ticoralak Pt. (54°15′N, 58°10′W)".

One specimen now in the collection of the Royal Ontario Museum (catalogue number ROM 21052) was captured by a commercial fisherman in Placentia Roads, entrance to Placentia Harbour, in July 1958.

Vladykov (1955) recorded the capture of an Atlantic sturgeon from Hermitage Bay, south coast of Newfoundland. This particular fish had been tagged 8 years earlier at Kamouraska, Quebec.

Two records were reported in a bulletin published by Canada's Department of Fisheries, entitled Trade News, volume 8, number 4, October 1955. One specimen 32 inches long was caught on the northwest coast, the other, 43 inches long, was caught at Wild Cove, Twillingate, on the east coast. Both captures were made incidental to the cod fishery.

It seems most unlikely that the Atlantic sturgeon spawns in Newfoundland rivers in view of the absence of freshwater records and the apparent rarity of salt water captures. It is worth noting that all the salt water captures mentioned above were made in July.

Alewife *Alosa pseudoharengus* (Wilson) 1811

The alewife or gaspereau is a rare species in Newfoundland waters, situated as it is on the northern limit of range for the species.

Study material consists only of a ripening male 236 mm. fork length (212 mm. standard length, ROM 21045), taken in the Little Codroy River, St. George's, 25-27 July 1960 by Mr. A. Murray, Fisheries Research Board of Canada.

Although there is no direct evidence of spawning in Newfoundland waters, Templeman (Ann. Rept. 1952, p. 60) recorded the collection of young, as follows: "Young gaspereau 10 cm. long taken in Holyrood Pond, St. Mary's Bay, gave the first record of probable spawning of gaspereau in the Newfoundland area".

An additional specimen, an adult male of 302 mm total length, was taken in Seal Pond rapids, Upper Humber River, 7 miles upstream from Deer Lake, on July 23, 1963 by Mr. Leo Young (ROM cat. no. 22496).

American shad *Alosa sapidissima* (Wilson) 1811

An anadromous species in Quebec and the Maritime Provinces, the American shad has been reported only twice from Newfoundland waters.

This species apparently reaches its northern limit of range in Newfoundland waters. In the Annual Report for the year 1932, Newfoundland Fishery Research Commission, Appendix D., page 125, is entered the following: "9. Shad (*Alosa sapidissima* Wilson). One specimen from traps at Bay Bulls, June 1932". Backus (1957) made no mention of the shad in Labrador. But Halkett (1913) implied by his statement, "Extends, or did extend, from Labrador, Newfoundland, Gulf of St. Lawrence, and Maritime Provinces, to Gulf of Mexico", that shad did occur in Labrador waters. This we have been unable to verify. Like Backus, Leim (1924) made no comment about shad in Labrador waters. Doubtless, shad occasionally are taken in marine shore waters of Newfoundland as stated by Lindsay and Thompson (1932) but such records seem not to have been published until now. The first fully documented record for the shad in Newfoundland waters is a 480 mm (total length) female taken in a salmon net in Wild Cove, Bay of Islands on June 13, 1963 by Mr. Lester Brake (ROM cat. no. 22368).

Lake whitefish *Coregonus clupeaformis* (Mitchill) 1818

The lake whitefish is a food fish of wide repute occurring in innumerable lakes and larger rivers in North America from the region of the Great Lakes northward to the Arctic Ocean. It is an important commercial species in the Great Lakes and in the large lakes farther north such as Winnipeg, Athabasca and Great Slave. Although widespread in neighbouring Quebec and occurring sparingly in New Brunswick, the whitefish is not native to Newfoundland but was introduced in 1886. The St. John's Evening Herald for February 23, 1892 carried a report of the Game Fish Protection Society in which were given details of the planting of various species of exotic fishes in ponds in

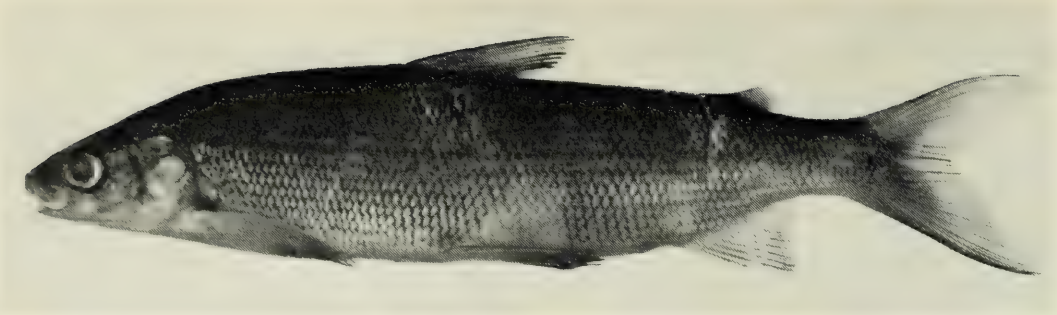

FIG. 1 Lake whitefish from Hogan's Pond, introduced from Lake Erie in 1886. (ROM 21034; ♂; 328 mm. total length)

the vicinity of St. John's. The fishes listed were game species except for the whitefish, which was covered in the following entry (see appendix):

"In March of the same year, [1886] there were imported 200,000 white fish ova and 500,000 salmon trout. The White Fish were hatched out in 21 days, and turned out into open water as follows:

Murray's Pond	50,000
Hogan's Pond (Broad Cove Road)	100,000
South Side Hills Pond	50,000"

A search through the Annual Report of the Department of Fisheries, Dominion of Canada for the year 1886 revealed some interesting entries. On page XXVI, in the first part of the report we read "Large shipments of semi-hatched ova of whitefish and salmon trout were made to Newfoundland and to the Colonial and Indian Exhibition in London."

In Part 2, page 43, of the same report, it is noted that 200,000 whitefish eggs were shipped from the hatchery at Newcastle, Ontario, to Newfoundland. Further study reveals that there were only two hatcheries in Canada caring for whitefish eggs in 1886, one at Sandwich, Essex County, western Lake Erie, and one at Newcastle, Durham County, on Lake Ontario. Both hatcheries, it will be noted, were located in Ontario. Although the whitefish eggs that were received in Newfoundland were actually shipped from the Newcastle hatchery, it is highly unlikely that the eggs were obtained from Lake Ontario whitefish. On page 49, Part 2, of the report, the manager of the Sandwich hatchery notes that he sent 3,000,000 whitefish eggs to the Newcastle hatchery—and this transaction is duly reported, in turn, by C. Wilmot*, the manager of the Newcastle hatchery. It would thus appear that the whitefish eggs sent to Newfoundland in 1886 were gathered in Lake Erie from Lake Erie whitefish, shipped to Newcastle where they were brought along to the eyed-egg stage and finally shipped to Newfoundland in March. There seems to be no reason to doubt that the whitefish eggs hatched in Newfoundland and subsequently planted were the product of Lake Erie whitefish.

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* C. Wilmot was a son of Samuel Wilmot, the man largely responsible for the building of the first full scale government hatchery in the western hemisphere —the Newcastle hatchery. Samuel Wilmot was the first manager of this hatchery and in 1886 was supervisor of Fish Culture for the Dominion of Canada.

It is of value to know the source of the original plantings because at least one of these was successful. During the 1960 survey 14 whitefish were caught by gill nets in Hogan's Pond. On the evening of July 28 a 100 yard length of gill net (50 yards each of 2 inch and 3 inch stretched mesh) was set more or less at random in the central portion of the pond in water ranging from 12 to 24 feet in depth. The nets were allowed to fish overnight and when lifted early the following morning they contained 11 whole specimens and the heads of 3 others. Eight fish were taken by the 2 inch net and six by the 3 inch. Eels, it would seem, had devoured the bodies of the other fish. To these 11 whole specimens from Hogan's Pond was added another caught by an angler in early July 1960, providing a total sample of 12 fish.

The fact that the stock for the Hogan's Pond planting originated in Lake Erie about 75 years ago makes it of especial interest. We know of no other successful transplant of whitefish, extending over a comparable period, for which the original stock is known and which has not been subjected to contamination by subsequent plants of different stock. The sample can provide some interesting information despite its small size.

In general the species may be said to be surviving well although growth rate is slow and emaciation is evident among the larger fish. A measure of the degree of emaciation can be seen by comparing body width of small and large fish (Table 1). The larger fish have some of the lowest absolute values (19 and 23 mm.) and certainly the lowest values if proportional measurements were employed.

The size of the sample precludes our obtaining an accurate analysis of the growth of the Hogan's Pond population but some interesting features are obvious. Four year classes are represented by the 12 fish. Considering the 1956 year class (age 4+) the smaller fish (nos. 2 and 4) are plump and apparently in good condition. In sharp contrast was the thin and emaciated condition of the larger specimens (nos. 11 and 12) of this same year class, specimens that, in addition, had gonads that appeared to have degenerated.

It seems probable that there is a relatively large number of whitefish in Hogan's Pond in view of the relative ease with which these

Table 1. Morphological data on lake whitefish from Hogan's Pond.

Specimen Number	Standard* Length	Total* Length	Sex	Age	Gill Rakers	Scales	Body	
							Depth	Width
1	215	271	♀ imm.	3+	28	74	57	27
2	219	273	♂	4+	26	84	54	26
3	222	271	♂	2+	29	84	53	24
4	223	269	♂	4+	29	80	54	25
5	252	305	♂	2+	28	83	63	29
6	263	328	♂	3+	28	84	61	28
7	263	335	♀ imm.	5+	30	85	56	19
8	268	332	♂	3+	30	81	63	24
9	273	337	♂	5+	32	89	60	26
10	277	350	♂	3+	29	86	63	27
11	278	346	♂ imm.	4+	30	83	64	23
12	292	362	♂ imm.	4+	29	78	68	29

*As measured in 1961 after shrinkage due to preservation.

specimens were caught, plus the fact that some are occasionally taken by fly fishing although little effort is exerted. This view is further strengthened by the presence of four year classes in a sample of only 12 fish. Quite possibly food is a limiting factor in the pond. It seems curious that the two largest fish possessed relatively undeveloped gonads and also that the only females caught showed no signs of egg development in late July. On the basis of these limited data it is suggested that the population of whitefish is overcrowded and that it might be improved by limited cropping. Probably the younger fish grow reasonably well until they develop sexually but do not recover after spawning. Yet spawning must be reasonably successful from year to year in order that four year classes be represented in a sample of 12 fish. Although the whitefish spawns in November and December throughout the Great Lakes region we have no knowledge of the time of spawning in Hogan's Pond.

The gill raker counts of the Hogan's Pond sample are of particular interest. Gill rakers are generally regarded as the most stable of the characters used in coregonid taxonomy and are generally thought to be least affected by environmental changes. If this premise is valid, the gill raker counts of the Hogan's Pond specimens should be essentially the same as counts from Lake Erie whitefish. A comparison shows that this is not so and that there is a marked difference in counts from the two lakes, the Hogan's Pond sample being the higher (Table 2). The means for the two samples are 27.6 for Lake Erie fish (Koelz, 1931,)

A typical inland freshwater pond.

Table 2. Gill raker counts of lake whitefish from Lake Erie, Ontario (after Koelz, 1931) and Hogan's Pond, Newfoundland.

	25	26	27	28	29	30	31	32	N	Mean
L. Erie	3	18	21	36	20	2	—	—	100	27.6
Hogan's Pond	—	1	—	3	4	3	—	1	12	29.0

and 29.0 for those of Hogan's Pond. These figures certainly suggest that a more critical study of the Hogan's Pond population should be undertaken.

A sample of 20 spawning fish was collected between November 26 and 28, 1963. These were caught by Fish Culture Officers Mercer and Chaplin, in Mitchell's Pond which adjoins Hogan's Pond. This extends the known distribution and provides a more adequate sample for comparison with mainland populations (ROM cat. no. 22502).

THE TROUTS, CHARS AND SALMONS

This widely distributed family of fishes, usually able to enter both salt and freshwater, is well represented in Newfoundland. Newfoundland fishes of this family are basically divisible into three groups; the chars (*Salvelinus*), the trouts and the Atlantic salmon (*Salmo*) and the Pacific salmons (*Oncorhynchus*).

Two chars (that group with pale spots), the brook trout *Salvelinus fontinalis* and the arctic char *Salvelinus alpinus,* are native to Newfoundland. The only trout (the black spotted group) native to the province is the Atlantic salmon *Salmo salar* but the brown trout *Salmo trutta* and the rainbow trout *Salmo gairdneri* have been introduced. The representative of the Pacific salmon, the pink salmon *Oncorhynchus gorbuscha,* was introduced as well.

These beautifully coloured or silvery, active fishes, especially the Atlantic salmon, which sometimes achieve weights in excess of 20 pounds, have always attracted eager sportsmen to Newfoundland. Some of the earliest discussions of freshwater fishes in this province are contained in the accounts of English sportsmen of their travels and adventures in Newfoundland. The early writings of many of these British or European sportsmen have at times caused confusion (Reeks 1871, Kennedy 1905, Morris 1937). They were not familiar with the brown coloured speckled trout of the freshwaters of Newfoundland and often assumed it was the brown trout *Salmo trutta* which they would have found in the same situations in their homelands.

Apparently an attempt was made to introduce another char, the lake trout—*Salvelinus namaycush,* into Newfoundland from the mainland of Canada. The Annual Report of the Department of Fisheries, Dominion of Canada, for the year 1886 (Pt II: 43) records the fact that 500,000 salmon trout eggs were sent to Newfoundland from the Newcastle, Ontario, Hatchery in 1886. Salmon trout is another local name, more in use then than now, for the lake trout. This shipment of eggs, the date of hatching, and the distribution of the resulting young is noted in the 1892 St. John's Herald story on the Game Fish Protection Society (see Appendix). No origin of the salmon trout eggs is given there and until the discovery of the 1886 report it may have been assumed these were brown trout eggs which had been received from Scotland as had 100,000 brown trout eggs in January of that same year. These lake trout fry were liberated in the following areas: Bay Bulls Pond, Old Perlican Ponds, Salmonier Ponds, ponds in Topsail vicinity, Quidi Vidi and Long Pond. No further introductions of this species were apparently attempted and there is today no evidence of the presence of lake trout in Newfoundland. This was apparently the only unsuccessful introduction of salmonids in Newfoundland. This may, in part, be due to the fact that the lake trout is probably the least salt tolerant species in the group and also a species for which no sea-run form has as yet been known.

Cat Arm River cascading into the sea on the east side of the Great Northern Peninsula. This obstruction prevents access by anadromous fish to all upstream areas of this river. (*Photo courtesy V. R. Taylor.*)

Boulder strewn stream and treeless landscape in the southern Avalon Peninsula.

KEY TO SALMONIDS OVER FIVE INCHES LONG

1 Anal rays 12-19; large, distinct, black spots on back and caudal fins, some as long as diameter of eye; sides silvery, back greenish.

PINK SALMON *Oncorhynchus gorbuscha*

Anal rays 7-12; many spots not as large as diameter of eye and black or coloured 2

2 Greatest number of spots on sides *black,* some orange to red spots may be present, but no pale spots 6

Spots on sides always white to pale pink, yellow or green-yellow; coloured spots (red or orange) may be present but no black spots present 3

3 Caudal fin or tail deeply forked; back dark steely blue to black; belly dusky grey or brightly coloured, orange to red.

ARCTIC CHAR *see* 4

Caudal fin scarcely or not forked but square; back olive to brown, belly yellow to orange; *or* back blue-green, sides silvery, belly white; body less robust more streamlined.

MUD TROUT or SEA TROUT *see* 5

4 Back dark steely blue; sides silver to copper colour, with pale pink or yellow to green-yellow spots; belly orange to bright red at spawning.

anadromous ARCTIC CHAR *Salvelinus alpinus*

Back olive-brown to dark blue or black; sides green to silver-grey with few, pale yellow to whitish spots; belly grey to dusky white or at breeding time orange to dark red.

non-anadromous or landlocked ARCTIC CHAR
Salvelinus alpinus

5 Sides brownish with large number of yellow round to oval spots and lesser number of bright red, round spots; back and dorsal fin brown to greenish, well marked with yellow, wavy vermiculations; belly and lower fins orange to yellow; all lower fins with milk white leading edge followed by black line.

non-anadromous MUD TROUT *Salvelinus fontinalis*

Sides silver with fewer, larger, greenish yellow to yellow or pink, round spots; back blue to green, wavy vermiculations absent or very inconspicuous; belly white; lower fins with milk white leading edge but dusky yellow to grey behind.

anadromous SEA TROUT *Salvelinus fontinalis*

6 Caudal fin deeply forked or slightly forked, if only slightly forked it is marked with many regular rows of black spots, adipose dusky or marked with black; maxillary does not pass posterior edge of orbit; branchiostegals 12 or 13; caudal peduncle narrow 7

Caudal fin not forked but square and with few or no black spots, adipose fin often orange or with orange and black spots, black spots more numerous on upper half of body; maxillary extends beyond posterior margin of eye; branchiostegals 10; caudal peduncle wide.

BROWN TROUT Salmo trutta *see* 9

7 Caudal fin deeply forked often with black posterior edge, it and adipose fin dusky and without black markings, large black spots on head; branchiostegals 12 8

Caudal fin forked but having radiating rows of black spots; adipose fin with black margin and/or black spots; few small black spots on gill cover; sides covered to varying degree with small round to oval black spots; often pink to rose band along mid sides; branchiostegals 13.

RAINBOW TROUT *Salmo gairdneri*

8 Back deep blue, sides silvery, belly white, body almost cylindrical and fat, head small; head and body with large, sometimes X shaped black spots; no parr marks or red spots visible on fish over 12 inches.

anadromous ATLANTIC SALMON *Salmo salar*

Back dark green to black, sometimes with brownish or golden sheen; sides silver-grey to dark grey, belly yellow-white to grey; body more laterally compressed; black spots more numerous and round; parr marks and red spots often obvious on fish up to 12 inches.

Ouananiche non-anadromous or landlocked SALMON *Salmo salar*

9 Back blue to blue-grey, sides silver, belly white; no orange or red spots, black spots without light borders; adipose yellow to orange but without orange spots.

anadromous or sea-run BROWN TROUT *Salmo trutta*

Back and upper sides brown to copper brown, belly yellow to white; rusty red or orange spots with pale outer rings, many black spots some with light borders; adipose orange to yellow often with orange spots.

non-anadromous or landlocked BROWN TROUT *Salmo trutta*

KEY TO SALMONIDS UNDER 5 INCHES

1 Anal rays 7-12; body with black or coloured spots and parr marks 2

Anal rays 13-19, no parr marks or black spots; probably not longer than two inches.

PINK SALMON *Oncorhynchus gorbuscha*

2 Coloured spots (red or yellow) on lateral line, between or on parr marks 3

In addition to parr marks only black spots on sides 5

3 With coloured spots along lateral line but no prominent black spots below lateral line. Parr marks prominent, dark, wide; some black on dorsal fin along the rays; often one large dark spot on operculum; ventral fins have milky leading edge followed by black line.

BROOK TROUT *Salvelinus fontinalis*

With coloured spots along lateral line but with definite black spots below lateral line 4

4 Prominent red spots on lateral line but black spots continuing down to level of the lower edge of the regular shaped, oval to circular, parr marks; dorsal fin with faint spots, adipose clear, caudal deeply forked, pectorals long, as long as depressed dorsal fin; branchiostegals 12.

ATLANTIC SALMON *Salmo salar*

(thought by some to be a trout and called "salmon peel")

Red spots along lateral line; small black spots above and below lateral line at least near pectoral fin; parr marks narrower; often large black spot on cheek; fins rounded, dorsal large with fine black spots near base; adipose orange in colour, caudal not greatly forked; pectorals very wide; branchiostegals 10.

BROWN TROUT *Salmo trutta*

5 Parr marks irregular in shape and position along side; lateral line passes through middle of about one-half of them; small black spots above lateral line only; very fine dark speckling along lower margin of parr marks; dorsal fin clear; adipose only dusky.

ARCTIC CHAR *Salvelinus alpinus*

Parr marks regular in shape (oval) and position along side; lateral line passes through lower one-third of each parr mark; smaller black spots above lateral line only, faint pink streak along lateral line; no dark speckling along lower side; dorsal fin with definite black markings; adipose with definite black border.

RAINBOW TROUT *Salmo gairdneri*

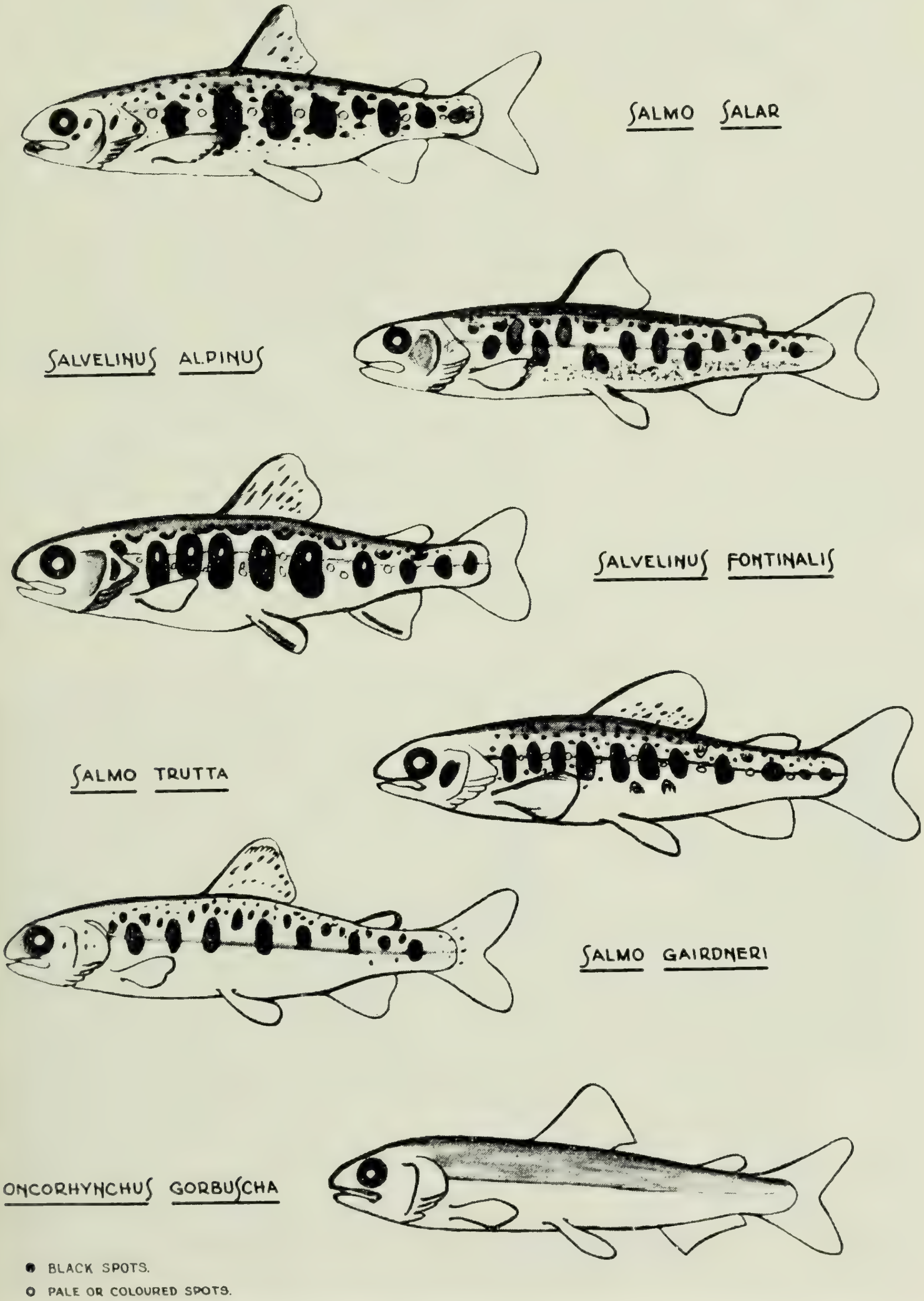

FIG. 2 Body shape and colour pattern in salmonids under five inches in length.

Pink salmon *Oncorhynchus gorbuscha* (Walbaum) 1792

This Pacific salmon, native to rivers of the Pacific slope from California to Alaska, northern Japan and Arctic drainages from Siberia to the lower Mackenzie River, is the most recent in Newfoundland of the many introduced fishes of the family Salmonidae. It has at present been introduced in only experimental numbers and the results are being carefully followed by the Fisheries Research Board of Canada.

A suggestion of the merit of an attempt to introduce this species into Newfoundland to establish a new commercial fish, was made by superintendent of Fisheries Nielson in 1896 (Annual Report 1932). This suggestion was apparently not implemented at that time. More recently preliminary investigations concerning the introduction of Pacific salmon into Newfoundland were begun in 1958 and the pink salmon was chosen as the most suitable species. It was thought that the rivers available in Newfoundland were more similar to the native habitat of this species than to those of any of the other Pacific salmon. Rivers of St. Mary's Bay were chosen as the most comparable and on November 5, 1958, two quarts of eyed eggs (5,700) were planted in the North Harbour River to determine survival overwinter and time to hatching (Annual Report, 1959: 49).

In the spring of 1959 fry recovery was 10.7 per cent and egg survival 62 per cent. Fry emergence occurred between May 7 and June 5 with a peak on May 26. None of these fry were released to proceed to sea (Annual Report 1961a: 56).

In November 1959, 250,000 eyed eggs were transferred from Indian River, British Columbia, and planted in artificial redds in the North Harbour River. Fry survival (to migration size) in spring of 1960 was 38 per cent. Most fry moved downstream between May 11 and May 20, 1960. Fry were observed in the estuary as far as 3½ miles from the mouth of the river (Annual Report 1961b: 45-46).

During the summer of 1960 two controlled flow channels were constructed on the North Harbour River at Herder's and Turfy pools, in preparation for the introduction of larger numbers of eggs. Peter's and Harricott rivers were investigated as possible alternative or additional sites for the introduction of this species.

While there had, to 1962, been only one adult return to the river from the original small experimental planting, work was continued to test the feasibility of large plants of eggs in order to attempt to establish a run of pink salmon in Newfoundland (pers. comm. J. L. Kask.)

Of the many attempts to establish Pacific salmon in the Great Lakes, only a recent (1956?) introduction of pink salmon into Lake Superior possibly at Port Arthur, Ontario, (Schumacher and Eddy,

1960) has yielded adult progeny from fish of the original introduction. Introductions of eggs made in various rivers in Maine in 1906, 1913-1917 and 1922-1926 resulted in brief periods of natural reproduction but there have been no reports of any pink salmon in Maine for many years (Bigelow and Schroeder, 1953).

This species, of all the genus *Oncorhynchus,* moves the least distance up stream to spawn. The fry migrate downstream almost as soon as they are free swimming. If their natural migratory behaviour is not disturbed by this transfer they should return to freshwater in the fall of the succeeding year as two-year-old adults. In their native environment, pink salmon move so short a distance into freshwater and are so near spawning when they approach that they are considered not to feed in freshwater and until recently rarely entered the angler's catch. However, several of the pink salmon taken in Lake Superior tributaries have been captured by anglers fishing with worms as bait (Schumacher and Hale, 1962).

Within the last five years price changes resulted in an attempt, by commercial trollers in British Columbia, to capture pink salmon in marketable quantities. Their efforts were successful and led to the use of several colourful, skirted lures similar to those used for largemouth bass. Anglers have successfully adopted the same gear and pink salmon are now regularly taken by anglers. If the species becomes established in Newfoundland it might support an estuarine sport fishery.

North Harbour River—the site of pink salmon introduction.

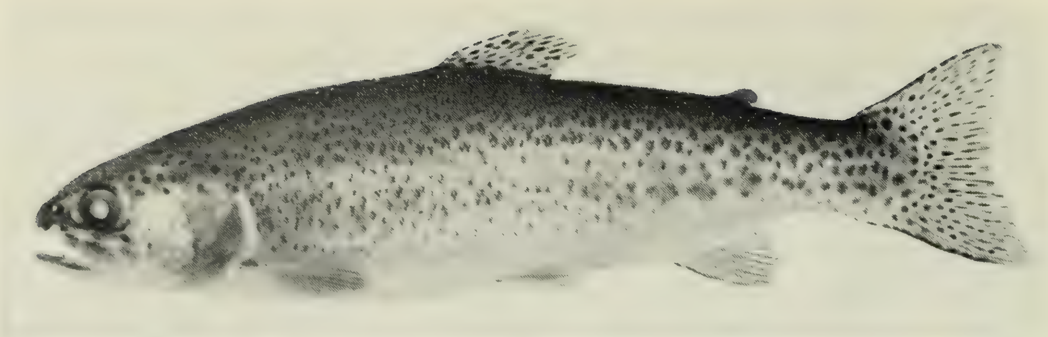

FIG. 3 Rainbow trout—introduced first in 1887, from California.

Rainbow trout *Salmo gairdneri* Richardson 1836
Salmo iridescens Californiensis—McNeily 1906
Salmo gairdnerii—Thompson and Frost 1937
Salmo irideus—Frost 1938

Other Common Names: steelhead or steelhead sea trout.

The rainbow trout, like the brown trout, is a fish that was introduced into Newfoundland. Rainbows, probably of a migratory or steelhead variety, were imported from California in 1887 and placed in Long Pond by R. A. Brehm (Frost, 1938). In 1890 and 1891 100,000 and 50,000 California rainbow trout eggs were imported, reared and liberated in Murray's Pond and other waters (see Appendix) on the upper Avalon. They were also planted "in some other parts of the Island" (Frost, 1938a). Eyed eggs were distributed as far distant as Notre Dame Bay (pers. comm. C. W. Andrews). In 1895 or 1896 a hatchery was built at Murray's Pond on the Portugal Cove Road, about 7 miles from St. John's and it is still in operation. Apparently eggs imported previous to this time were hatched in the Long Pond hatchery. The populations in the ponds around St. John's were maintained by yearly liberations of 60,000 fry (Frost, 1940). Until 1961 fingerlings from the hatchery have been liberated in the St. John's area, but recently the hatch has been kept overwinter before release (pers. comm. C. W. Andrews). That the original stock was steelhead variety (as opposed to stream or lake resident rainbows) is also inferred from several published statements of the necessity of fencing the outlets of ponds with connections to the sea, into which they had been introduced, to prevent losing them. Thompson and Frost (1937) stated "that there is some evidence that the rainbow trout also adopts the sea-going habit in Newfoundland waters". There is, however, no evidence of any stream having an established sea-run population. In spite of periodic, unconfirmed reports of the capture of "steelheads" there is no substantial anadromous population in any stream on the Avalon Peninsula and it is unlikely, therefore, that there are any significant sea-run populations on the Island.

DISTRIBUTION

As a species the native distribution of the rainbow trout is limited to the Pacific slope of North America from Baja California to Bristol Bay, Alaska. Steelhead, the sea-run variety, do not extend south beyond the rivers of southern California. This species has been widely introduced throughout North America beyond this range and into many foreign countries.

Very little is known of the true extent of the distribution of the rainbow trout in Newfoundland. Records of the Game Fish Protection Society indicate that while the great majority of rainbow trout distributed were planted in ponds of the Avalon Peninsula (mostly in the vicinity of St. John's), small numbers were shipped as far afield as Little Bay Islands, Notre Dame Bay (1906—5,000 eyed eggs, 1908—5,000 fry). There are also unsubstantiated reports that fry may have been released in ponds near Corner Brook on the west coast of the Island.

There may have been survival from the plantings in the "Little Bay Area" since there have been several reports, from anglers familiar with rainbows, that a pond near Tilt Cove, Notre Dame Bay, supports a population of this species. The Tilt Cove area, though now connected by road, was in the early years of this century, separated from Little Bay only by a few hours' boat ride. Similar reports are received occasionally from the Corner Brook area.

There can be no doubt that the main concentrations of rainbow trout resulting from these early plantings are in the northern part of the Avalon Peninsula, but there may be a few isolated populations that have survived in widely separated areas on the main part of the Island.

No specimens of this species were taken on the 1949 or 1960 surveys and there are to our knowledge no Newfoundland specimens in any research collection.

DESCRIPTION*

In stream resident rainbows the back is dark blue to black, the sides greyish to yellow-green with a great many small circular black spots. The belly is white to greyish. Spots also occur on back, dorsal fin and caudal fin. Black spots on the caudal are in regular, radiating rows along fin rays. There is a pink band down the centre of each side. This band becomes very red and the over-all colour much darker in spawning males. Spawning females are dark on the back, rather golden on sides and grey-yellow on ventral surface and the lateral band is not so conspicuous.

In rainbows resident in large lakes (Kamloops type in B.C.) and in anadromous steelhead the back is steel-blue to deep green, the sides very silvery with a lesser number of black spots. The lateral band is pink and more diffuse, the belly is white and the fins spotted as in stream resident trout. Spawning colour in these forms resembles that of the stream residents.

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* Description (including Fig. 3) based on eastern Canadian material since no Newfoundland specimens were available.

SPAWNING

All forms of rainbow trout are spring spawners, lake resident and stream resident forms spawning in Newfoundland in late March to the end of April (Frost, 1940) or mid-May (Frost, 1938a). The lake forms run up inlet and down outlet streams to spawn. Spawning site and activity are very similar to other salmonids.

Steelhead move from the ocean into the rivers to spawn at about the same time each year but not at the same time in each river. In their native habitat the main runs are "winter runs" (December to April) but some rivers have summer runs (May to October). Some rivers have both types of runs so that adults are always present. However, those that run into the rivers in the summer do not spawn until the following spring.

Spawning of lake and stream residents first occurs at age three or four (8-10 in. in length) for males and possibly a year sooner for females. Steelhead young commonly remain in freshwater two years (2-4) before migrating so that first spawning for them as well is at age three (3-5) (Larkin, 1948). All rainbow trout may spawn more than once—stream and lake residents probably at least every other year and steelhead at least twice during life.

Lake resident fish move from lake to stream and the young from stream to lake much like those movements of steelhead between freshwater and the sea. Lake-resident trout hatching in inlet streams usually enter the lake in the first year but those spawned in outlet streams often overwinter in the stream and go up to the lake the following spring.

Seaward migration of steelhead is usually in March to May and smolt size, depending on time in freshwater, is approximately 152-206 mm. (6″-8″) fork length (Maher and Larkin, 1955).

Egg development time depends on water temperature and hatching time has varied from 32-65 days in Newfoundland (Frost, 1940).

FOOD

As in the other salmonids the food of all young rainbow trout is composed of the immature forms of various aquatic insects, bottom dwelling crustaceans and to a much lesser extent plankton. Larger lake resident rainbows (over 12″) may feed almost exclusively on small fishes if they are abundant and readily captured. Otherwise their food will be the same as the young. Steelhead at sea no doubt feed on shore fishes and marine crustaceans as do the anadromous forms of the other salmonids. It is believed that adult steelhead, when they re-enter freshwater, rarely take food of any sort. However, they do bite at hooks baited with food items and even late in the summer, summer-run fish are in good condition after several months in freshwater.

GROWTH

Stream resident fish seldom exceed 2-3 pounds (18 inches) and average ½-¾ pounds; lake resident rainbows where food is abundant have been recorded as large as 36 inches and 52½ pounds (Carl, Clemens and Lindsey, 1959) but usually average 1-2 pounds. The presently accepted angling record (Field and Stream Magazine) is a trout taken from Lake Pend Oreille, in 1947. It weighed 37 pounds and was 40½ inches in length. They apparently have a considerable growth potential which requires only adequate food and no competition from other fishes, to be realized. McNeily (1906) stated that Newfoundland fish stocked in 1890 were caught as 2 pound fish in 1892 and at least one 7 pound fish from the same group was caught in 1895.

Rainbows in Murray's and Butler's ponds are slow growing and at six years of age reach approximately 305 mm. in length and a weight of 9.9 ounces. The record rainbow taken from these ponds over the period 1902-1959 was a 5 pound, 5 ounce fish caught in 1951 (pers. comm. C. W. Andrews).

A newspaper report in June 1962 carried a picture of a seven and one-quarter pound rainbow taken by an angler from a pond "in the Bauline Line Area", near St. John's.

Since little is as yet available on growth of rainbows in Newfoundland, growth of lake resident and sea-run varieties from British Colum-

Table 3. Growth of three types of populations of rainbow trout (fork length in inches)

AGE		2	3	4	5	6
LAKE RESIDENT Kootenay Lake, B.C.[1]	Mean	10.2	11.9	17.8	18.5	21.7
SEA-RUN B.C.[2]	Mean		18.7	27.5	31.8	38.0
GREAT LAKES-RUN Ontario[3]	Mean Range		16.3 (12.0-19.0)	21.4 (15.5-25.5)	23.3 (21.0-25.0)	23.3 (22.0-24.5)

[1] Larkin *et al*, 1957
[2] Maher and Larkin, 1955
[3] Wainio, 1962

bia is shown in Table 3 with that of rainbows introduced into Ontario which "run" to the Great Lakes. In the latter case the rainbows spend 1-3 years in the spawning stream and 1-4 years in one of the Great Lakes where growth potential corresponds to that of the sea. Morris (1937) reported the capture of a 22 pound rainbow in Manuels River, Newfoundland, in 1911. If this was a steelhead or rainbow it is a record but Manuels River has a well established population of sea-run brown trout and quite a few large sea-run browns have been taken near the estuary of that stream. Since this weight of 22 pounds fits within the recorded size range of sea-run *Salmo trutta* and since rainbow trout of over 10 pounds appear to be unknown it seems likely that Morris' record was a sea-run brown trout rather than a sea-run rainbow trout. Frost (1940) suggested that the growth rate of rainbow trout in Newfoundland is retarded through lack of large food.

McNeily (1906) and Frost (1938a) reported that most Newfoundland anglers "believed" or "conceded" that rainbow trout provided better sport than the "Native" or mud trout and Frost (1940) recorded that in Murray's Pond they gave the club members slightly better success (1.63 fish per fisherman, June to August 1938, as compared to 1.28 fish per fisherman for mud trout in the same period).

A not atypical scene on Newfoundland's salmon and trout rivers. This shows pulp logs moving downstream over a "splash" dam in central Newfoundland. Since this picture was taken, a pool and weir fishway has been constructed over this combined falls and logging dam to make the upstream areas accessible to Atlantic salmon and sea trout. (*Photo courtesy V. R. Taylor.*)

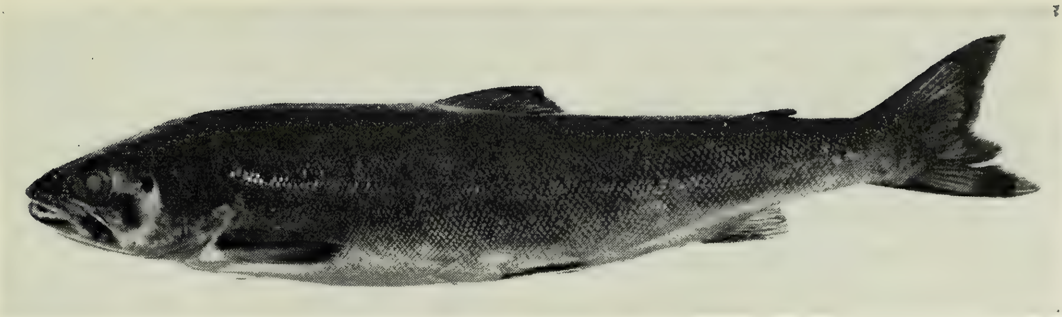


FIG. 4 Landlocked Atlantic salmon—also called ouananiche, winnish or black salmon. (ROM 21028; ♀; 435 mm. total length)

Atlantic salmon *Salmo salar* Linnaeus 1758

Stations: 5, 8, 14b, 17, 23, 24a, 25, 27, 28, 30.

Collections: 2, 7, 10, 11, 12, 13, 25.

Other Common Names: nonanadromous or landlocked form-ouananiche; winnish; salmon peel; salmon peel trout.

There will be no attempt here to cover sea run or anadromous salmon since they are the subject of concentrated effort in Newfoundland by the Department of Fisheries of Canada and the Fisheries Research Board of Canada. The importance of these stocks to commercial fishermen and anglers is obvious to the point that rivers scheduled for Atlantic salmon are even specially marked on road maps. Angling in these rivers requires a special salmon license and use of flies only. Anadromous salmon run in most, if not all, of the rivers of the Island that are adequate in size and environment. For thorough coverage of anadromous salmon of Newfoundland see the publications of the Newfoundland Fishery Research Commission, Newfoundland Department of Natural Resources (Fishery Research Institute, Fishery Research Laboratory), Fisheries Research Board of Canada, Department of Fisheries of Canada, Quebec Salmon Commission (Contr. Inst. Zool., Univ. de Montréal) and Department of Fisheries, Quebec.

Since there is a considerable amount of research carried out by the Department of Fisheries on Atlantic salmon in Newfoundland and their distribution is well known, no effort was made to collect migratory salmon or to collect in obvious salmon habitats in rivers in which they are known to run. A grilse of 512 mm. F.L. was taken in Lake St. George (Sta. 14) and one of 448 mm. F.L. was taken in Gambo Lake (Sta. 24). Each of these had indications of two years of freshwater and one year of sea growth. Most other salmon, taken in streams, were between 35-120 mm. F.L. and showed only one or two years of freshwater growth.

Ouananiche

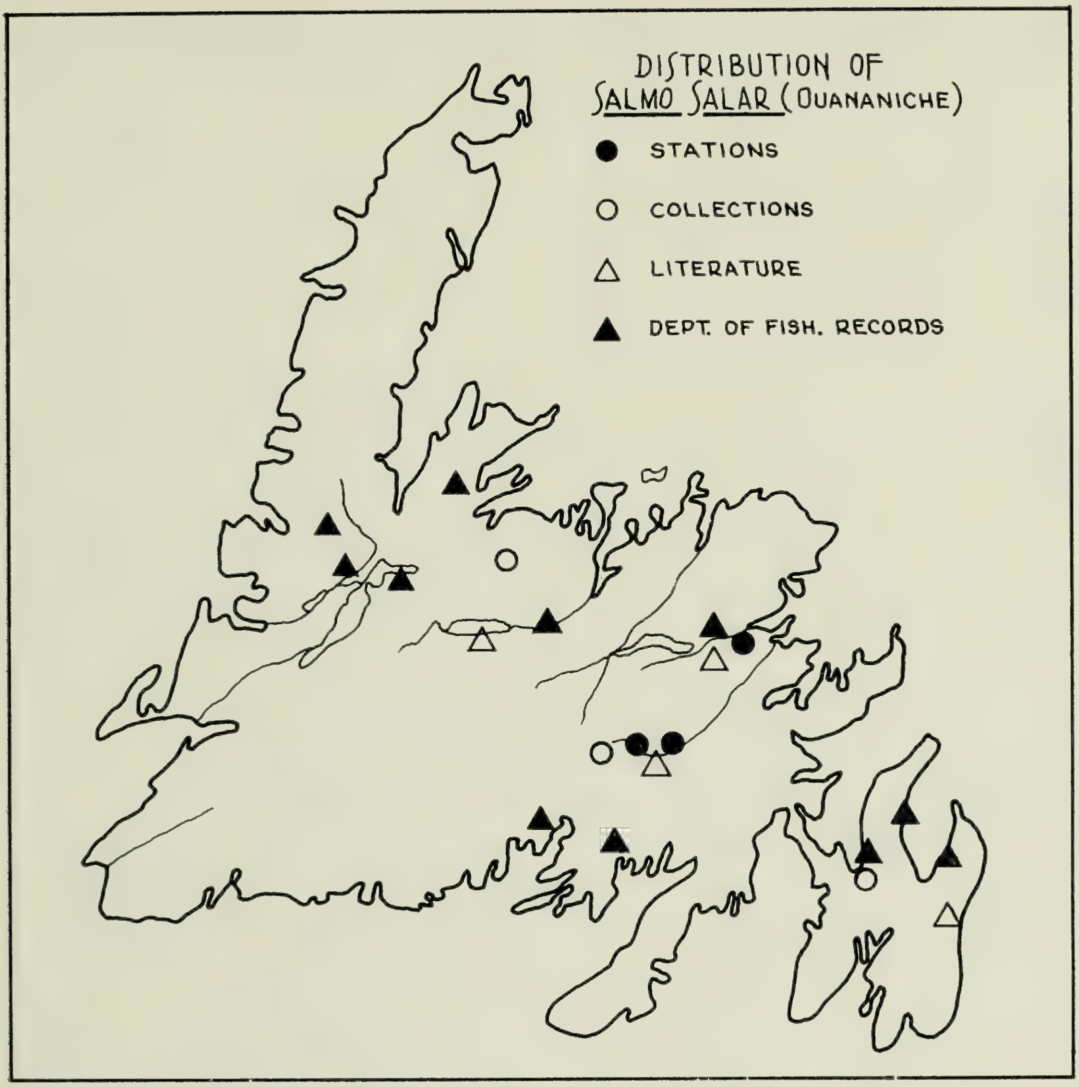
Six other specimens of *S. salar,* taken half way up Lower Gambo Lake (Sta. 24), were as old as 6 + but showed only freshwater growth. This would indicate the presence of a well defined nonmigratory population of *S. salar* as well as an obvious anadromous population in the lake. Gambo Lake had both types of speckled trout as well (i.e. migratory and non-migratory).

A much larger sample of ouananiche (73-481 mm. F.L.) taken from Deer Pond (Sta. 28) and Lake St. John or John's Pond (Sta. 30), of the Terra Nova system, were all nonanadromous. Access to these lakes from the sea was, until 1953, barred by Grant's Falls or Lower Falls (difficult but not impassable), Terra Nova, Big or Upper Falls (impassable) and a level-control (logging) dam at the foot of Lake St. John. A fishway, completed at Upper Falls in late 1952, made the area between this former obstruction and the dam at Lake St. John accessible to the 1953 run of anadromous salmon. The dam at the outlet of Lake St. John still prevents entry into the lakes above it.

DISTRIBUTION

In North America, ouananiche are found in Newfoundland, Quebec, Ungava, New Brunswick, Nova Scotia, Ontario, Maine, New Hampshire and New York. They inhabit lakes that are distributed along the fringe of the presumed maximum extent of Pleistocene glaciation in North America (Power, 1958). Halkett (1913:52) in his distribution of *Salmo salar ouananiche* listed them as occurring in Newfoundland in Red Indian Lake, Terra Nova Lakes, and lakes at the head of Gambo River. The present survey did not add to this list. Ouananiche were reported to be in Long Pond Bay Bulls (Frost, 1940).

Landlocked salmon have been found in greater or lesser numbers in all major, and many minor, watersheds that have received even limited investigation. Brief examination by Department of Fisheries personnel (usually incidentally to other work), and others, during the past four or five years has revealed their presence in such widely separated areas as Rocky River, Manuels River, Dildo Brok, and others on the Avalon Peninsula; Gambo River, Terra Nova River, and Middle Brook, on the east coast; Salmon River (Bay d'Est River), and Bay du Nord River, on the south coast; Exploits River and Middle Arm Brook (Baie Verte Peninsula), on the northeast coast; and the Humber River watershed on the west coast. As yet there have been no confirmed reports of ouananiche on the Great Northern Peninsula, but this is in all probability due to the lack of investigation and of significant angling pressure on standing waters in that area.



In summary, landlocked salmon have been found to be widely distributed throughout the Island in those areas investigated, or that receive significant angling pressure. It may be confidently expected that they will also be found in those other areas that, to date, have received no investigation or little angling pressure.

Ouananiche have been taken as deep as 70 feet but are more often nearer the surface. In this survey they were taken in gill nets set in 12-25 feet of water in both Gambo and St. John's lakes.

Description

In contrast to the fat, silvery, anadromous salmon, ouananiche are more laterally compressed, the head, tail and some other body parts appear larger, the colour is much darker (although some in Labrador are silvery) and spots are more abundant. In summer adults are dark green to black on the dorsal surface of the head and body, the sides are light to dark, silvery grey and the ventral surface yellow-white to grey. The fins are usually dark grey to black but may be flecked with yellow or green.

According to Wilder (1947) there are usually 3-8 spots on the operculum, the body spots are smaller and more numerous than on anadromous salmon and extend below the lateral line. There are usually 25-75 spots above the line and 10-25 below. There are 10-25 black spots on the dorsal fin. In spawning season adults develop a pinkish band one half inch wide along the lower side from the head to the base of the caudal. At this time the operculum is golden and the caudal fin reddish brown. There are no sexual differences in spawning colour. Ouananiche resemble kelts or the adult river stage of anadromous stocks and the flesh colour is white to pale yellow throughout life.

There is, in these nonmigratory stocks, a tendency toward retention of juvenile characteristics. While there were no coloured spots on adults from Lake St. John, there were obvious parr marks on individuals as long as 485 mm. F.L. The young stages, to parr, are indistinguishable from those of anadromous salmon.

While the head and often the caudal fin of ouananiche appear larger than migratory salmon, this can be attributed to slow rate of growth (White, 1936). Comparisons of morphometric characters of all stages of migratory salmon with ouananiche fail to show any significant differences (Wilder, 1947). Genetically the stocks are similar and any differences which exist are usually considered due to the environment.

Table 4 gives frequencies for pyloric caeca and gill rakers in the Lake St. John sample of ouananiche and compares the mean counts for Newfoundland with those given by Wilder (1947) for other populations in eastern Canada. As in the case of similar data for Newfoundland speckled trout, the mean number of gill rakers for this Newfoundland population of ouananiche is little different from those for populations on the mainland of Canada. This sample indicates that Newfoundland ouananiche have far fewer pyloric caeca than any mainland population but the difference is no greater than the difference between two mainland populations. It might then appear to be a simple north-south cline. However, the figures in the table appear in order of latitude, north to south, and are therefore not consistent with a latitudinal clinal variation. Also, since the variability is as great between populations on the mainland as between the lowest mainland population and the Newfoundland population these figures cannot be considered as indicating a distinct insular population of ouananiche in Newfoundland.

Controversies as to the origin and cause of "landlocking" still rage. It is obvious, however, that it is largely physiological isolation

Table 4. Numbers of pyloric caeca and gill rakers in ouananiche from Lake St. John (Station 30)

Pyloric Caeca

40	41	42	43	44	45	46	47	48	49	50	51	52	N	Mean
1	1	1	1	—	6	1	—	2	—	1	1	1	16	45.7

Gill Rakers

Upper Limb

7	8	N	Mean
8	7	15	7.5

Lower Limb

11	12	13	N	Mean
3	9	3	15	12.0

Total

18	19	20	21	N	Mean
2	6	5	2	15	19.5

Means of counts for various populations in Eastern Canada

Location	Mean No. Pyloric Caeca	Mean Total Gill Rakers
Lake St. John, Terra Nova, Newfoundland	45.7	19.5
Lake St. John, Quebec	63.3	19.1
Chamcook Lake, New Brunswick	62.0	18.8
Grand Lake, Nova Scotia	53.1	19.7

rather than physical isolation as stocks of non-anadromous salmon exist in waters completely accessible to and from the sea. These two forms of *Salmo salar* are comparable to the two forms of *Salmo gairdneri,* the anadromous steelhead and the lake form, or Kamloops trout.

The silver, freshwater, smolt stage of the anadromous salmon and the land-locked form have long been considered a form of trout by many anglers in Newfoundland and called salmon peel or salmon peel trout.

SPAWNING

While ouananiche do migrate from the lake to spawning streams if adequate conditions are available, it has been reported that they will spawn on gravelly shoals in the lakes (Kendall, 1935). They apparently utilize both inlet and outlet streams. The majority of those that spawn in an outlet stream, even one open to the sea, return to the lake after spawning (Warner, 1959). It is probable that young ouananiche found below dams or falls represent the progeny of adults which migrated up from the lake below to spawn. They spawn in the fall and initiation of spawning activity is usually stimulated by increased flows, following rains, of moderately cold water in the lake tributaries. Ova are well developed in September and spawning takes place in October. As in the anadromous stocks the males run first. The mean number of eggs produced by females varies with size. Mean egg numbers of 965 to 2,253 have been recorded for females from 2.2 to 4.1 pounds. (Kendall, 1935). Some males are apparently sexually mature at 10 inches (2+ or 3+), (Atkins, 1884).

FOOD

As with all salmonids the young—to parr stage—feed almost exclusively on insects, immature aquatic forms browsed from the bottom and adult forms taken on the surface. The young will apparently prey also on the newly laid eggs of speckled trout. The adults feed primarily on fishes although adult insects, aquatic and terrestrial, are frequently eaten. Often lakes which contain thriving populations of ouananiche also contain good populations of smelt. The food of adults is then almost exclusively smelt.

The stomach contents of ouananiche up to 160 mm. F.L. from Lake St. John consisted of insect material alone, mainly caddisflies. Those of larger salmon were composed mainly of the remains of fish. This food consisted of unidentifiable species (probably salmonids), *Gasterosteus aculeatus,* and two very small *Osmerus mordax*. This last is interesting since no other smelt were taken in any of the samples from Lake St. John or Deer Pond although *Osmerus mordax* has been reported from the Terra Nova system. Frost (1940) reported that subadult ouananiche from Long Pond, Bay Bulls, had been "feeding well on bivalves, amphipods and other bottom food."

GROWTH

Ouananiche as large as 39 inches and 35½ pounds have been reported from Sebago Lake, Maine, as large as 7 pounds from Lake St. John, Quebec (Kendall, 1935), and 44¾ pounds from Lake Ontario, Ontario (Fox, 1930). The presently accepted angling record (Field & Stream Magazine) is a 36 inch salmon taken from Sebago Lake, Maine, in 1907; it weighed 22 pounds, 8 ounces. The same record list states that a 35 pound fish was taken from Crooked River, Maine, by some means other than angling. The average weight of landlocked salmon, however, is probably 2-3 pounds; the females somewhat heavier than males.

The largest ouananiche in the sample from Lake St. John, Newfoundland, was 481 mm. F.L. (20 inches) and a live weight of approximately 2½ pounds (preserved weight, 2 pounds, 10 ounces).

Generally speaking, the larger waters seem to carry the larger ouananiche. There have been frequent reports by Fishery Officers, and others, of fish 20 pounds and over being seen on the spawning grounds, and the occasional one angled. Although it has not been possible to fully confirm any of these reports, there is little reason to doubt that some of the bigger waters do carry fish of quite a large size. Due to the inaccessibility of many of these waters, angling pressure is either quite limited or nonexistent. Some of the larger specimens examined by Fish Culture Branch personnel in recent years are listed below (see Table 5). These are, with the exception of the specimens from Red Indian Lake and Flatwater Pond, from anglers' catches.

Table 5. Records of large ouananiche taken in Newfoundland waters.

Place	Date	Sex	Fork Length (in.)	Weight (lbs.)	Age
Flatwater Pond, Middle Arm Brook	1958	♀	19.5	3.1	10
Flatwater Pond, Middle Arm Brook	1958	♀	19.7	3.4	9
Deer Pond, Terra Nova River	1956	—	18.0	3.5	9
Kaegudeck Lake, Bay du Nord Riv.	1958	♀	21.5	7.0	8
Kaegudeck Lake, Bay du Nord Riv.	1958	—	17.5	—	6
Kaegudeck Lake, Bay du Nord Riv.	1958	—	16.0	—	6
Kaegudeck Lake, Bay du Nord Riv.	1958	—	16.0	—	6
Red Indian Lake, Exploits River	1961	♂	27.8	8.5	11

Frost (1940) said that ouananiche in Long Pond, Bay Bulls averaged between 23 and 33.5 cm. (9-13¼ inches) in length.

Ouananiche in many smaller waters on the Island, particularly those of the Avalon Peninsula, seldom seem to exceed 10-12 inches in length. Generally speaking, it does not seem that their growth rate is particularly slow (for this area), but rather that it does not usually exceed a certain maximum size. A few examples from waters of the Avalon Peninsula (angled) are listed in Table 6. Perhaps this small maximum size may be attributed to lack of forage species.

The age-length relationship (Table 7, Fig. 6) from scale readings shows that the growth rate of the Lake St. John population is almost identical to that for a population of ouananiche in Lac Aigneau in northern Quebec as reported by Power (1958). It is significantly

Table 6. Records of ouananiche from the Avalon Peninsula.

Place	Fork Length (in.)	Weight (lbs.)	Age
Bullrush Pond, Rocky River	11.6	0.4	5
Whiteheart Pond, Rocky River	8.8	0.2	3
Whiteheart Pond, Rocky River	5.7	—	3
Whiteheart Pond, Rocky River	4.4	—	1
Whiteheart Pond, Rocky River	6.3	—	2
Whiteheart Pond, Rocky River	5.3	—	2
Forest Pond, Petty Hr. River	9.0	—	3
Forest Pond, Petty Hr. River	7.9	0.25	2
Forest Pond, Petty Hr. River	10.3	0.5	3
Forest Pond, Petty Hr. River	9.3	0.4	3
First Pond, Petty Hr. River	8.0	0.25	4
First Pond, Petty Hr. River	7.2	0.25	3

lower, at least from IV onward, than that for a population in Astray Lake reported by Power (*ibid.*). Backus (1957) gave age and lengths of a small sample of ouananiche from Flour Lake, Hamilton River, Labrador. These are in reasonable agreement with Table 7. It seems likely that considerable variation in growth rates (even in the same general area) between populations in separate waters will become

Pulp logs piled up along a river.

evident as more information is compiled for the Newfoundland area. These variations will probably prove to be due to variations in the basic productivity of the waters and perhaps also to the presence or lack of suitable forage species. Growth in all three of the areas discussed (*i.e.* Ungava, Labrador, and the Island of Newfoundland) is considerably slower than that reported for Maine (Everhart, 1950). This slow rate of growth in the Terra Nova system may be the result of an inadequate forage fish population. It would appear to take four to five years for ouananiche in John's and Deer ponds to reach a minimum size attractive to anglers (6-8 inches F.L.).

Table 7. Age-length relationship and sex ratio of 41 land-locked salmon from the Terra Nova River System

(Totals do not agree as not all the specimens aged were sexed)

Age		1	2	3	4	5	6	7	8	N
Number Specimens		4	10	9	4	5	5	3	3	43
Mean F.L. mm.		123	153	208	235	290	319	374	464	
Sex Ratio	♂	1	4	3	2	2	4	0	3	19
	♀	2	4	6	2	3	1	3	0	21

The discrepancies between length at various ages as interpreted from direct measurements (Table 7) and back calculations (Table 8) may be the result of small sample size. It may also be due to the fact that only the bigger members of the younger age groups were taken in the mesh sizes used.

Table 8. Age-length relationship as back calculated from the scales of three age VIII and four age VI land-locked salmon from the Terra Nova System

Age	1	2	3	4	5	6	7	8
Mean Calculated F.L. mm.	66.5	112.5	161.5	203.8	255.8	307.8	361.2	418.0

The sex ratio of a sample of 40 individuals from the Terra Nova system was 21 females to 19 males. The larger fish gave no apparent indication of greater longevity for one sex, as all the age VII fish were males and all the age VIII were females.

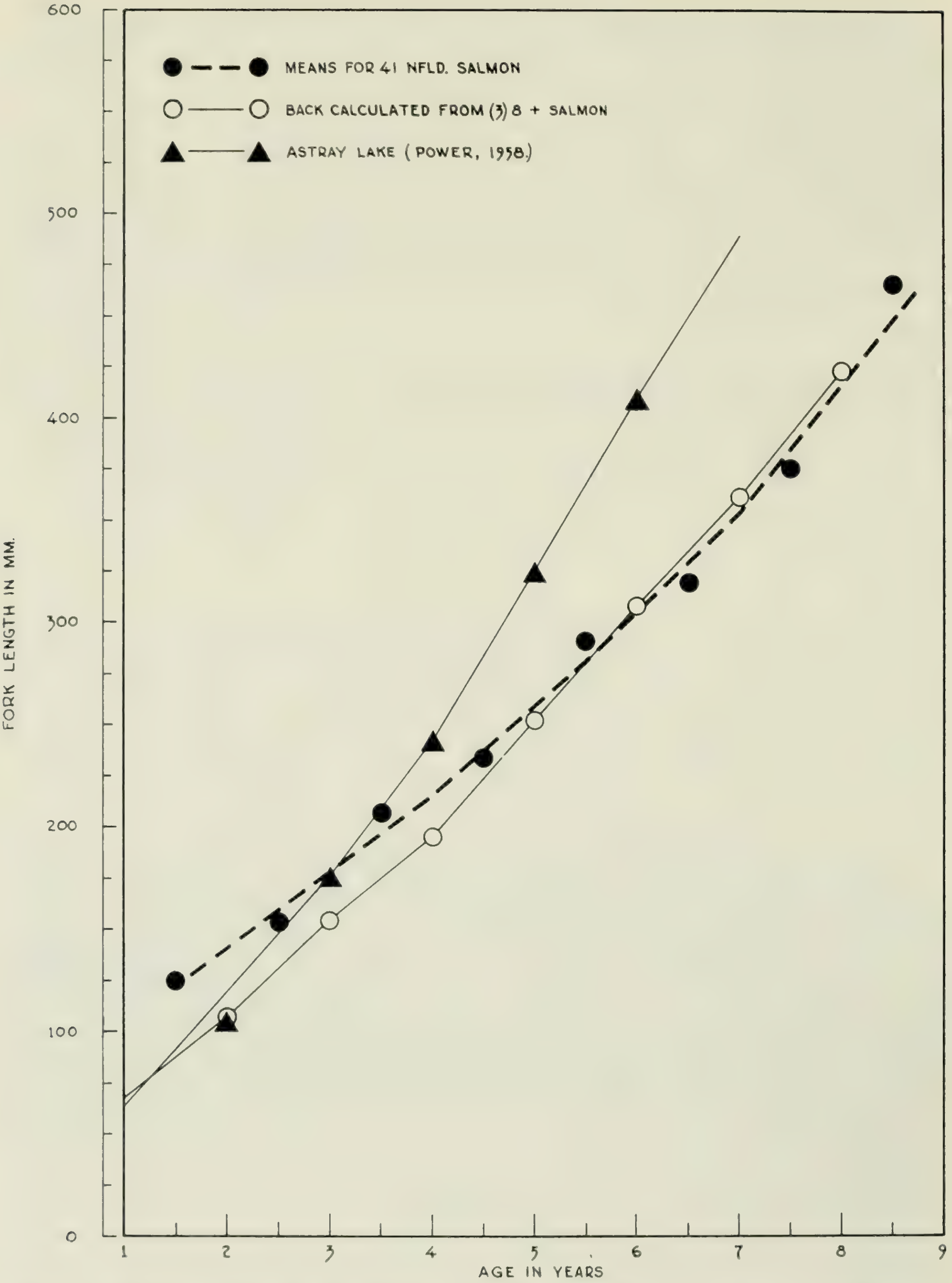


FIG. 5 Age-length relationship, (means for years, and back calculated) for Newfoundland ouananiche compared with that for Astray Lake, Quebec (Power, 1958).

There are, no doubt, many unutilized and underutilized populations of this fish in insular Newfoundland. Some stocks are inaccessible except by air (especially lakes of the south coast river systems) while many others are accessible only by private roads which are frequently closed to the general public. Other ouananiche populations may be in areas where the more highly prized anadromous salmon and sea trout or mud trout are readily caught. Under these conditions, little effort is exerted toward angling for ouananiche which may be a little more distant and call for somewhat different angling techniques. The colour and body shape make ouananiche seem less desirable to anglers. The angling qualities of this species are extolled in other areas, but in Newfoundland the ouananiche is not extensively fished. These almost unexploited stocks of salmon could, and no doubt will in the future, contribute substantially to angling in insular Newfoundland. There can be no conflict or competition between sport and commercial fishermen for the available fish. The fact that the ouananiche suspends feeding for a much shorter time than anadromous salmon makes them more readily available over a greater portion of the season. The necessity of angling for these lake fish with methods and gear different to those that are, by tradition and legislation, in common use, may be a deterrent to adequate utilization of these non-anadromous *Salmo salar*.

PARASITES

Frost (1940) reported that ouananiche from Long Pond, Bay Bulls, "had numerous Acanthocephalae in the intestines and many had tapeworms".

Typical company-controlled access road—the only kind of road in much of the interior.

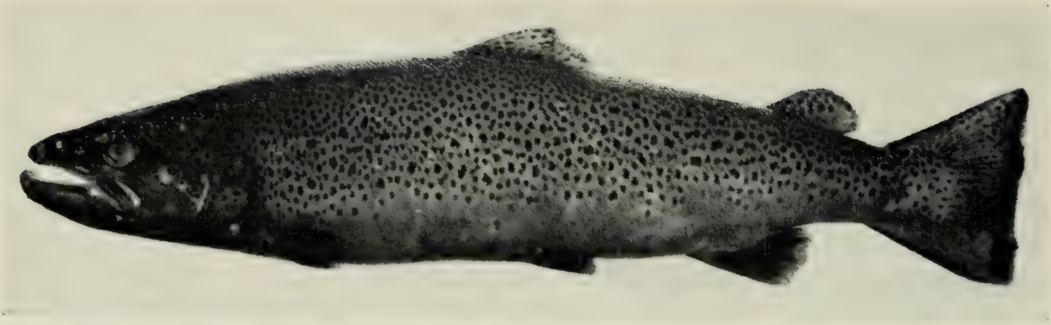


FIG. 6 Adult male brown trout from a searun population of the Avalon Peninsula. (ROM 21966; ♂; 666 mm. total length)

Brown trout *Salmo trutta* Linnaeus 1758

Stations: 6.

Collections: 11, 22, 26.

Other Common Names: German brown trout; Lochleven trout.

This is an introduced species in Newfoundland and its entry into this area was only a year after the first introduction of this species into the Americas. In 1884 Mr. John Martin of the St. John's Game Fish Protection Society introduced Lochleven trout in Long Pond and other lakes near St. John's (Frost, 1948a). These came from the hatchery of Sir James Maitland in Scotland (McNeily, 1909). In 1889, hybrids (*Salmo trutta* x *Salmo salar*?) were put into Quidi Vidi River (See appendix). In 1892 Mr. R. A. Brehm and others introduced German brown trout into Whiteway's and Robin's ponds, in the vicinity of Torbay, and Hodgewater Pond near Brigus (Frost, 1938a). English brown trout eggs were sent to Newfoundland in 1905 or 1906 and planted in Clemen's (Clement's) and Lee's ponds near St. John's (Frost, 1940). For a more complete list of dates and locations of early introductions of this and other species, by the Game Fish Protection Society, see appendix.

The stocks used for the introduction of this species into Newfoundland no doubt came from those areas for which different names were at one time in use: German brown trout=*Salmo fario,* Lochleven trout=*Salmo levenensis,* English brown trout=*Salmo trutta* or *Salmo eriox*. Later, brook-resident browns were called *Salmo fario* and sea-run browns *Salmo trutta.* All forms are now recognized as only varieties of brown trout, *Salmo trutta,* with small morphological differences resulting from geographical and habitat isolation. Means of distinguishing between the various varieties (even sea-run and non sea-run trout) disappear when they are kept in the same water.

Introductions apparently stopped "many years" before 1940 (Frost, 1940) so brown trout have obviously maintained and extended their distribution in Newfoundland by natural reproduction.

DISTRIBUTION

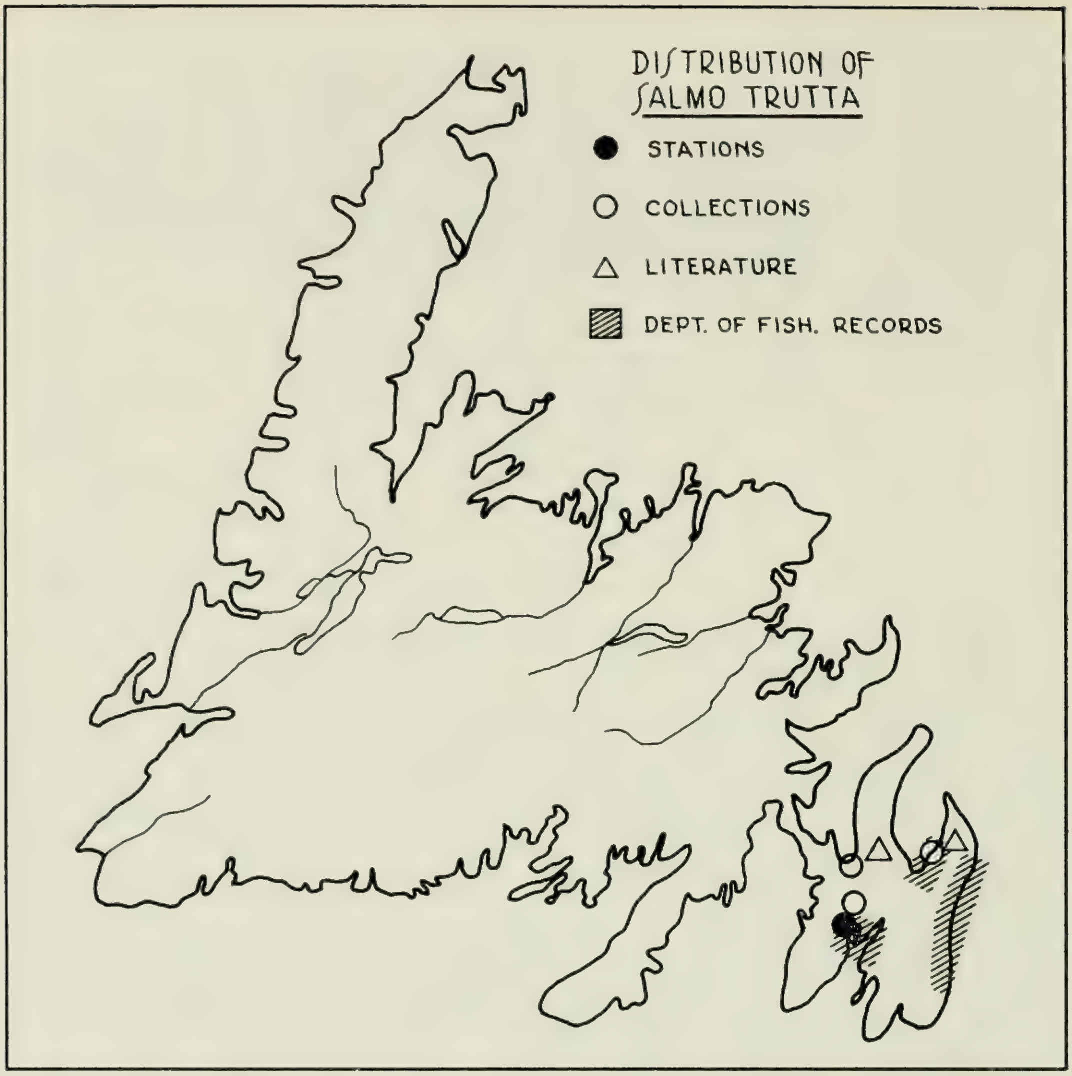
The natural distribution of this trout includes Iceland, the British Isles, Europe and Asia west to a line from Cape Kanin to the Aral Sea, south to a line from Syria to Afghanistan and includes the northern tip of the western Mediterranean coast of Africa (Wiggins, MS).

In Newfoundland, while it has spread from the original plantings in ponds in the St. John's area, it is apparently still limited to the Avalon Peninsula. Although unconfirmed reports suggest that occasional specimens may appear in some streams of the east or northeast coasts of the main section of the Island, in 1949, according to H. W. Walters, then Chief Game Warden, Newfoundland Department of Natural Resources (pers. comm.), the distribution, other than ponds mentioned above, was as follows: Atlantic drainage—rivers from St. John's to Renews River; Conception Bay—rivers from Portugal Cove to Avondale; Trinity Bay—Heart's Content to Chapel Arm and Dildo Pond; St. Mary's Bay—Colinet River to Salmonier River. It has without doubt extended its range since that time as evidenced by the fact that the only specimen taken during the survey and Collection No. 26 came from the North Harbour River of St. Mary's Bay. Reeks (1871) said "the Salmon Trout (*S. trutta*) abounds all along the coast, and is usually taken in nets by the settlers." Morris (1937) quotes Hensman as saying, in *Badmington's Magazine of Sport,* in an article on shooting and fishing in Newfoundland, that "The brown trout is the most common of its kind, and is found in every river in the Island in considerable abundance". These statements were surely meant to refer to the brook trout *Salvelinus fontinalis* and not to the introduced brown trout *Salmo trutta* whose distribution is limited. This is also the case with Kennedy (1905) who says, "the brown trout . . . is most widely distributed". He was referring to the mud trout which he called *Salmo fontinalis.*

DESCRIPTION

At one time experienced anglers claimed to be able to distinguish by colour and shape the various varieties, but when two were confronted with a single fish they often disagreed. Frost (1938a) gave the following descriptions: "German brown—golden tint over a light background on which are dark brown and a few red spots; Lochleven—a yellowish tint generally confined to the operculum. There are black spots but no red ones and the tail is less forked than the German brown. When found in the same pond, however, specimens have been seen which seem to bear characteristics of both varieties so that any distinction is difficult".

In the case of both nonanadromous and sea-run browns, after having been in freshwater for some time, the back is deep brown to



bluish grey, the sides golden to light brown and the belly white to yellowish. On the back, upper sides (usually more above the lateral line) and dorsal fin are black spots, some with light borders. Rusty red to orange spots with light yellow or pale halos are found on the sides. The caudal fin is square, not forked, has at times a few spots on the upper lobe and the edges of both lobes are marked with black and white lines. The base of the tail or caudal peduncle is very stubby and thick. The adipose fin is large, spotted and often of an orange or yellow hue.

Sea-run browns are silvery like Atlantic salmon and are often mistaken for Atlantic salmon. When in the sea or fresh run the back is deep blue to black, the sides silvery and with only a small number of large, black spots above the lateral line close to and on the head. The tail is square and unmarked. All other fins are dusky and without colour. The deep peduncle, square, clear caudal fin and the fact that the maxillary bone of the brown trout is longer than the maxillary bone of Atlantic salmon should distinguish sea-run brown trout from salmon or other sea-run trout. If not, a count of the scales running obliquely down from the adipose fin to the lateral line, and a count (left side) of the branchiostegals or bony supports of the floor of the mouth should separate them.

	Scales	*Branchiostegals*
brown trout	more than 13	generally 10
Atlantic salmon	less than 13	generally 12

SPAWNING

Brown trout are late fall to early winter spawners. While it is usually later than mud trout and sea trout there are records of brown trout and brook trout utilizing the same spawning grounds at the same time (Greeley, 1932). Greeley observed spawning activity in Michigan between November 4 and November 25 but believed that the period was longer. Carl (1938) reported that ripe fish were taken in the Cowichan River, B.C., from October 15 to January 16 but that fish were present in the spawning tributaries only between November 12 and December 17. Spawning in some areas does apparently carry into January. Freshet conditions after heavy rainfall rather than temperature of water seems to initiate spawning activity. Brown trout will seek the same type of spawning sites as brook trout if available but there are records of them spawning in Lake Superior on rocky reefs close to shore (Eddy and Surber, 1960).

Some brown trout are sexually mature before age three but most are three or older. Nall (1930) gave records of a sea-run brown with two years of freshwater and eight years of sea life which had spawned in each of the last seven of its sea years.

The female digs the redd and spawning generally occurs in the daytime after extensive courtship behavior. The eggs which are amber (in contrast to the orange or pink of other Newfoundland salmonids) average 2,020 (667-2,352) per female in their fifth and sixth years (Carl, 1938). The eggs of only one pair are deposited in a redd but each trout may pair again with others and spawn in other redds (Wiggins, MS). The eggs generally hatch in April but the time to hatch depends on water temperature. Hatching times for some of the early eggs imported into Newfoundland and reared there were: salmon trout—73 days, Lochleven trout—106 days. After hatching alevins usually emerge from the gravel of the redd in late April or early May.

FOOD

Larger brown trout feed mainly at dusk and to a certain extent during the night (Needham, 1938). Included in the food of brown trout studied in various areas were plankton, gordiaceans (roundworms), earthworms, amphipods, crayfish, many aquatic and terrestrial insects, centipedes, millipedes, spiders, molluscs, salamanders, frogs, lampreys, fishes and mice (Wiggins, MS). Trout of all sizes appear to feed on insects and particularly those of the orders Trichoptera, Ephemeroptera, and Diptera. There are indications that browns feed on insects taken from the surface of the water to a greater extent than do other trouts, char and salmon. Trout as small as four inches have been known (Idyll, 1942) to eat fishes but usually fishes do not form a significant part of their diet until they exceed 12-13 inches in length. The larger brown trout get, the more prominent the proportions of fishes and crayfish in the diet become. All of these variables no doubt depend on the relative abundance of various food items of appropriate size. In other areas salmonids, sculpins and sticklebacks are the most common fishes eaten. This also reflects availability rather than selection.

Winter food of brown trout is little known but Idyll (1942) reported salmon eggs (*Oncorhynchus sp.*) and young trout from stomachs of brown trout taken in the Cowichan River, British Columbia, in winter.

Growth

The over-all record for brown trout (sea-run) is 39 pounds, 4 ounces for a 40½ inch trout taken in Loch Awe, Scotland, in 1866. Trout weighing up to 14 pounds have been reported from Ontario waters (Scott, 1954) and there is a record of 18 pounds, 3 ounces from Oregon. Actually little is known of the growth of brown trout in Newfoundland. Morris (1937) reported catching, in 1920, a brown trout of over 19 pounds off the mouth of Seal Cove River, and catches of other anglers at Kelligrews of 50 fish averaging 6 pounds. The St. John's Biological Station of the Fisheries Research Board of Canada has records (pers. comm.) of two sea-run brown trout taken in recent years from Witless Bay, near St. John's. One fish taken in 1960 weighed 27 pounds, 10 ounces; the other, taken in 1962, weighed 28 pounds, eight ounces. Scales read by station personnel indicated that both fish were approximately 13 years of age. Frost (1940) reported that in Newfoundland sea-run brown trout "grow in weight to 22 pounds with 10-15 pounds being fairly common".

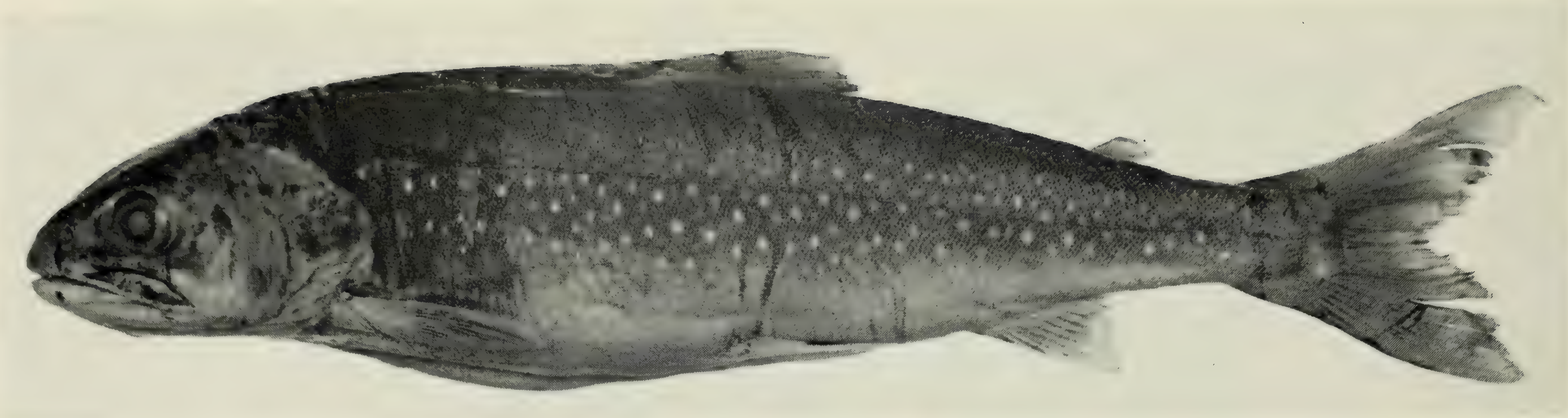
The brown trout from Newfoundland in the collection of the Royal Ontario Museum are: a 293 mm. F.L., four year-old, nonanadromous trout from Dildo Pond; two sea-run brown trout from the North Harbour River, one of 298 mm. F.L. (whose scales showed three years of freshwater growth and two of sea growth), and the other 661 mm. (26 inches) F.L.; and one of 198 mm. F.L. from Manuel's River.

It was claimed by some anglers that in Newfoundland brown trout appear to do better in smaller side streams than in main rivers. As in almost every area into which brown trout have been introduced, the

Grand Lake, with a length of 60 miles and shorelines of breathtaking beauty.

controversy concerning their effect on native trout rages in Newfoundland. Chief Game Warden Walters (pers. comm.) claimed the brown trout "appears to have crowded out the speckled trout which formerly was available in practically all waters now taken over by the brown trout". This ability to displace the speckled trout is usually noticed in warmer waters. It is the greater capacity of the brown trout for sustained activity at higher water temperatures that enables it to succeed where brook trout cannot. It is not simply the ability to survive at high temperature as both species have nearly comparable limits in this regard. However, in streams of Newfoundland, especially those open to the sea, the problem of water temperature should not be too great.

Another attitude of some anglers is that sea-run brown trout are rarely caught in good condition. Walters reported (pers. comm.) in 1949 that he had fished from the 15th of April until the end of October, taking possibly 150-200 sea-run brown trout and did not catch one that he would class in good condition. He reported that in his opinion the flesh was like that of a fish that had spent its time in brackish water and not in the sea and was thus unable to acquire the colour and flavour associated with sea-run trout. He likened them to salmon that have been in the river for a month or two. Frost (1938a) reported that the "German brown variety at least is good eating when in good condition". She went on to say that "brown trout are generally considered to be less sporty than either rainbow trout or char".



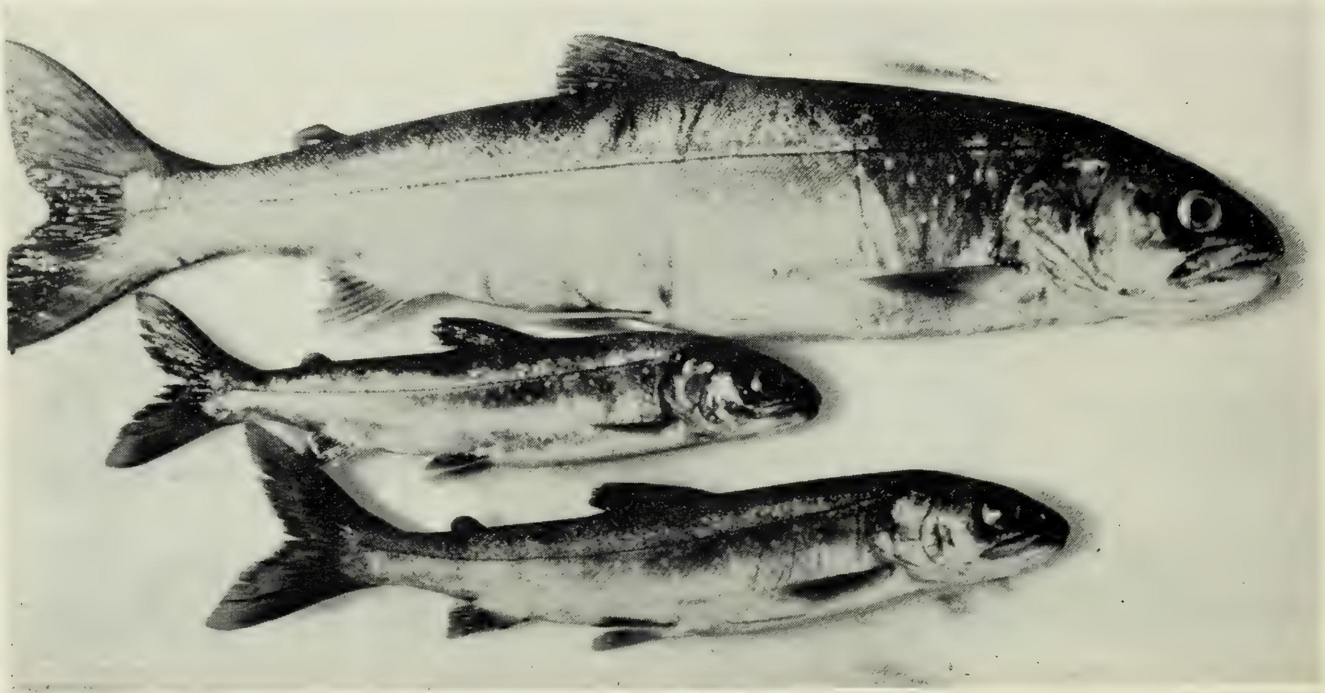


FIG. 7 Arctic char are landlocked in many of Newfoundland's deep lakes. Lower photo shows the same fish, (ROM 20998; 349 mm. total length) with two immature char, freshly caught.

Arctic char *Salvelinus alpinus* (Linnaeus) 1758

Stations: 11b, 14a, 14b, 20.

Collections: 1, 2, 10, 14, 15, 16, 21, 23.

Other Common Names: Parson's Brook Smolts (at Gambo Lake).

DISTRIBUTION

The presence of arctic char in insular Newfoundland went undetected until 1949 when specimens captured by a survey party of the Department of Natural Resources of Newfoundland at South Twin Lakes (Exploits R.), Blue Gorge and Hind's Brook of Grand Lake (Humber R.), Gander Lake, Moreton's Harbour Pond, Landown's Pond (Harry's R.), Mobile Big Pond, Ocean Pond and Dildo Pond were forwarded to the Royal Ontario Museum and were identified as this species. This Museum has specimens taken previous to this date (Coll. 21:1948) which, however, were not received until after 1949. The locations from which char were taken on the survey and locations of supplementary collections at ROM are listed above and detailed in the tabular lists (pp. 110-116). In addition to these locations, records of the Fish Culture Development Branch, Department of Fisheries of Canada (Newfoundland Area), show that landlocked char also occur in Square Pond—Middle Brook, Gambo and Deer Lake—Humber River. The Annual Report of the Fisheries Research Board of Canada (1952:60) recorded that arctic char were found in the waters of the Terra Nova system above the falls. No young or adults were seen or collected by the authors in the many collections in and around Lake St. John (John's Pond) and Deer Pond of this system. Other populations of non-anadromous char will in all likelihood be located in the future. The Fish Culture Development Branch of the Department of Fisheries also has records of at least one population of anadromous Arctic char running in Parker's River (West R.), Pistolet Bay and other populations of this form may exist in the northwestern section of the Province.

Arctic char, which are circumpolar in distribution, are anadromous in rivers in the arctic and subarctic regions. Landlocked or non-anadromous populations occur in various places along the southern fringe of this range. In North America nonanadromous stocks are found in Alaska, Quebec, Newfoundland, New Brunswick, New Hampshire and Maine. After examining specimens of nonanadromous Arctic char from Newfoundland, McPhail (1961) considered them to be relict populations as he did the other eastern North American landlocked forms. In Labrador the landlocked form was encountered much less frequently than the anadromous form and south of Nain both forms appeared to be replaced by *Salvelinus fontinalis* (Backus 1957).

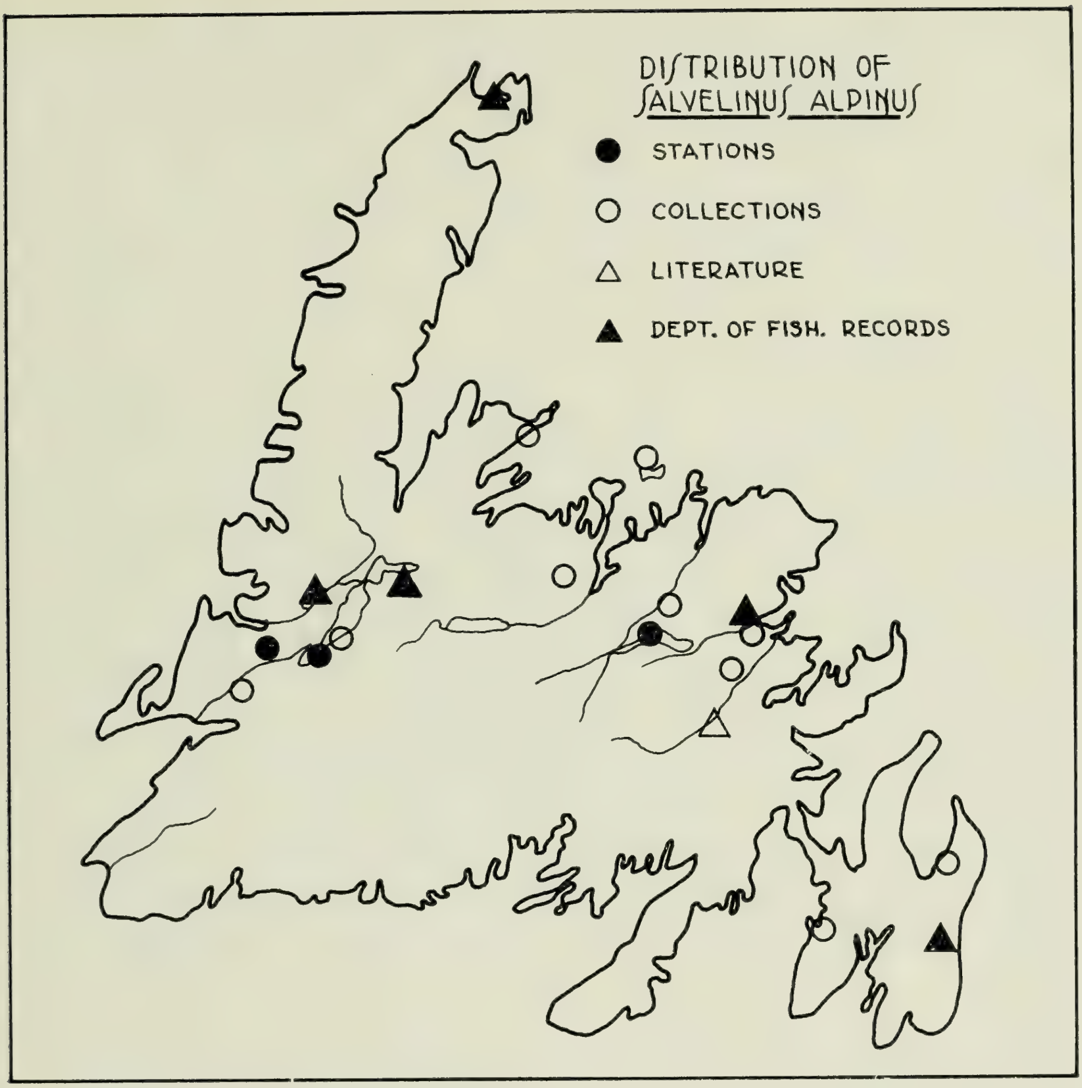
DESCRIPTION

Landlocked arctic char in Newfoundland have dark dorsal surfaces and pale to brilliantly coloured ventral surfaces. The back and sides to below the lateral line are grey-blue to blue-black as are the dorsal, adipose and caudal fins and head. The lower sides and belly are silvery to yellow-white (females and non-spawners) to deep orange or red (spawning males) depending on sex and condition. In most cases the leading edges of lower fins, edge of the lower lobe of caudal fin and undersurface of the jaw are white to yellow. This white on the fins was absent in specimens from Gambo Lake and Caplin Cove Brook. The trailing edges of lower fins are orange and the central portion of these fins dusky to black on breeding males. The dark areas of the sides are marked with a small number of moderate sized, pale spots without halos. Anteriorly the spots are more abundant below the lateral line; the reverse is true posterior to the dorsal fin. The mouth is large, the maxillary extending well beyond the eye and well toothed. The caudal fin of Newfoundland Arctic char is markedly forked. Males develop hooked snouts during spawning period. The kype does not develop to the extent it does in Atlantic salmon. The Arctic char seen in the month of July on the survey were all of the less colourful pattern. The back and upper sides were dark blue to black, the lower sides and belly were grey-white to pale yellow and the spots were small and not overly prominent. Specimens collected from Butt's Pond in September and October 1958 were much more colourful, the backs of males were dark and the ventral surfaces orange to dark red and the spots almost indiscernible on mature males. The females were paler but the spots were obvious.

The range of colour from place to place in Newfoundland, between sexes and over the season is extensive and confusing. Department of Fisheries personnel who have collected specimens at spawning time have remarked on the fact that the lateral line is prominent and raised above the surface of the sides.

Anadromous Arctic char are somewhat similar to sea trout in that the dorsal surface is steel-blue to blue-green, the sides silvery to blue and marked with large white to pink spots; the lower sides and belly milky white. The fins are paler and dusky to pink but do have the white edges. Proportional differences between anadromous and landlocked char, possibly strongly correlated with variable growth rate, have been described. Backus (1957) recorded that the nonanadromous form in Labrador had longer fins, a larger eye and a thicker caudal peduncle.

Pyloric caeca and gill raker counts have been considered useful as a means of separating salmonids. Although the Newfoundland sample is



small (12) and is a composite from several locations, the counts are shown in Table 9, as are comparable counts from a Labrador landlocked population given by Backus (1957). The variation in number of caeca is high and the sample size small in both these cases. There appears, in this species, as well as in speckled trout, to be a difference in the frequency distribution and total number of caeca between these figures for landlocked populations and the figure for sea run specimens from Labrador given by Backus, 1957. The range in number of caeca, 36-40, cited by Oliva (1951) for landlocked char in Iceland could fit into this distribution or might be higher.

Gill raker counts for nonanadromous arctic char were obtained for Stations 11, 14 and 20 and Collections 1, 3 and 23. These are shown in Table 9, compared with counts for specimens from Katherine River, Labrador, given by Backus (1957). The frequencies result in only a somewhat lower range for insular Newfoundland specimens as

Table 9. Number of pyloric caeca and gill rakers in land-locked arctic char in Newfoundland compared with land-locked char in Labrador

NUMBER OF PYLORIC CAECA	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Insular Newfoundland various localities	2	1	—	1	1	—	1	2	1	—	—	—	—	1	1	—	1	—
Katherine River, Labrador (Backus, 1957)	—	1	—	—	1	1	—	1	—	2	1	2	4	2	—	—	—	2

NUMBER OF GILL RAKERS	Upper Limb						Lower Limb						
	7	8	9	10	N	Mean	13	14	15	16	17	N	Mean
Insular Newfoundland	1	7	7	1	16	8.5	2	8	5	1	—	16	14.3
Katherine River, Labrador	—	1	10	7	18	9.3	—	6	6	4	1	17	15.0

	Total								
	21	22	23	24	25	26		N	Mean
Insular Newfoundland	2	4	7	1	2	—		16	22.8
Katherine River, Labrador	—	—	5	2	8	2		17	24.4

compared to those from Labrador. While the samples in both cases are small these figures would tend to indicate no distinction in the Newfoundland populations from mainland char. The intermediacy of these Newfoundland counts as compared with the counts given for Labrador and for *S. oquossa* and *S. aureolus* from Maine (Backus, 1957) tends to amplify the concept that the Maine populations of sunapee and blueback trout are not distinct from other populations of nonanadromous *S. alpinus.*

SPAWNING

Nonanadromous Arctic char in Butt's Pond spawn in late October and early November possibly every year as opposed to every other year as cited by Grainger (1953). They apparently spawn in a shallow rocky bay which has a water depth of three to ten feet.

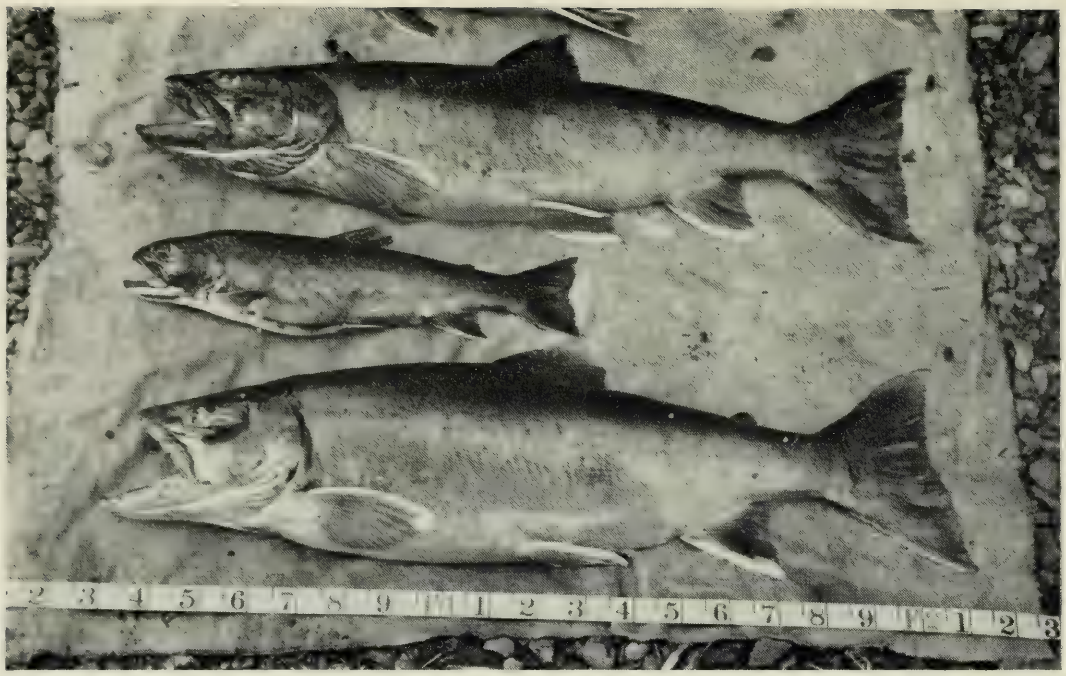
Gonad examination revealed that some female char in Newfoundland are sexually mature in their second year but most males do not ripen before the third year. Nordeng (1961) said that migratory char in Norway spawn for the first time only after their fourth seaward migration. As is most often the case with salmonids mass movements to the spawning grounds are made up of more males than females in the beginning (Unpub. data, Can. Dept. Fish., Fish Cult. Dev. Br.). Backus (1957) reported Arctic char, nonmigratory, in Labrador mature at four inches in length. He saw none larger than 10 inches. In the char taken by the 1949 party there was a 5½ inch ripe female taken from Gander Lake.

FOOD

The succession of food items with increase in size would be similar to that of the other salmonids. Young char feed on bottom invertebrates and the older and larger ones on fishes. When landlocked smelt are present these would probably constitute the major item of diet of larger char.

GROWTH

Growth of landlocked arctic char in Newfoundland like that of ouananiche is slow. This is possibly correlated with the paucity of suitable forage fishes, especially in the deeper water that the char inhabit. Records of the Department of Fisheries, Newfoundland, show that the oldest char from Butt's Pond was nine years of age and of 48.6 cm. or 19.1 inches fork length. Growth rate was variable and after five years of age males were bigger and heavier than females of the same age. Usually the reverse is true. The length and weight of Arctic char at various ages from Butt's Pond and the total Newfound-



Two large male landlocked arctic char (top and bottom) just prior to spawning time, and a smaller brook trout (centre) from Butt's Pond. The large char weighed 4.2 pounds. Note the prominent milky white colouration on the leading edges of the pelvic, anal and caudal fins.

land sample are shown in Table 10. Age determination was by scale reading and is tentative, pending corroboration by otoliths. Scales have long been considered of dubious value in the analysis of the age of Arctic char, migratory or land-locked. The otoliths are preferred. Nordeng (1961) in an intensive study of the problems involved in aging techniques for this species came to the conclusion that in small stationary (non-anadromous) char, the scales generally register age in the immature stage only. He also concluded, by comparing winter marks on otoliths and scales that to achieve the correct age from scale readings one year had to be added in the case of immature fish and 1 to 6 for mature fish. Ages as expressed here from scale readings alone may only be the ages at which fish (whose mean fork length at capture is given) matured sexually. The accuracy of this portion at least, seems high as the independent analyses of two people were very consistent. The relationship for char in Newfoundland is shown in the table with that for char from Shona Lake, Baffin Island. Although considerably to the south of the Shona lake char those in Butt's Pond grew more slowly and lived for a much shorter time. Lakes on the mainland often have a much greater fauna of potential forage fishes compared to insular Newfoundland where those available to char in deep water are almost restricted to other salmonids and smelt.

Table 10. Relationship of age to length and weight in two populations of land-locked Arctic char

AGE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Butt's Pond	Mean F.L. mm.	80	163	159	170	255	371	435	464	486											
	in.	3.2	6.4	6.3	6.7	10.0	14.6	17.1	18.3	19.1											
(Dept. Fish. data)*	Mean wt. oz. lbs.		1.7 oz.	1.6	1.9	7.1	1.7 lbs.	2.3	2.7	2.9											
Shona Lake	Mean F.L. mm.						203	556	566	584	714	701	752	734	765	822	826	908	921	1133	917
(Pers. comm. L. Johnson)	in.						8.0	21.9	22.3	23.0	28.1	27.6	29.6	28.9	30.2	32.4	32.5	35.7	36.3	44.6	36.2
New-foundland Sample excluding Butt's Pond**	Mean F.L. mm.	127.6	153.0	152.5	207.3	241.5	307.0														

*Age by scale analysis by Department of Fisheries, Newfoundland.
**Age by scale analysis, Ontario Department of Lands and Forests.

Arctic char living in the deeper lakes or deeper areas of other lakes not only face special problems but are not often seen. Mr. Lane, Department of Fisheries Guardian at Gambo Lake, said that where they are found in Parson's and Triton Brook at spawning time they were recognized as different from mud trout, sea trout and Atlantic salmon and were called "Parson's Brook smolts". Mr. T. Curran (Department of Fisheries, Fishery Officer) stated (pers. comm. V. R. Taylor) that the only time that they can be caught in Gambo Pond is during late winter (when smelting or trouting through the ice) or in the early spring up to the end of May. Angling in deeper waters of many of the larger lakes may reveal the wider presence of this species.

Sea-run or anadromous arctic char

While only one population of searun Arctic char is presently known from insular Newfoundland some basic data on this form in Labrador is provided. For more thorough discussion of these searun char see Grainger (1953), Andrews and Lear (1956) and Backus (1957).

Anadromous char which overwinter in the lakes begin to run to the sea shortly before or with the breakup of river ice in the spring. All the run is apparently in the sea by the end of July (Andrews and Lear, 1956). They return to freshwater in the autumn of that same year—the larger female fish in advance of the others (Grainger, 1953). They are not such good jumpers as Atlantic salmon so depend on moving in with ebb tides to get them over obstructions. Spawning is in the fall but apparently all mature females do not spawn every year.

In the sea they apparently feed mainly on fishes, capelin comprising over 80% of their diet. Sand lance, mailed sculpin, assorted amphipods and euphausids make up the rest of the diet in Labrador (Andrews and Lear, 1956).

The length range of char taken in the gill net commercial fishery along the Labrador coast was 30.0-79.9 cm. F.L., the greatest number were in the 7-9 year group and maximum weight was 8.2 pounds. This contrasts with weights of 12 pounds at 24 years in Frobisher Bay (Grainger 1953). Growth rate in Labrador decreases and maximum age attained increases progressively in populations from various rivers from south to north (Andrews and Lear, 1956). Table 11 compares the age length relationship for two populations of anadromous Arctic char.

Sexual maturity is usually achieved between the sixth and seventh winters and first seaward migration takes place between the fifth and seventh winter (Grainger, 1953).

The commercial fishery for Arctic char on the Labrador coast averaged 571 barrels or 125,602 pounds of pickled char per year be-

Table 11. Age-length relationship for two populations of anadromous arctic char

Age		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Frobisher Bay (Grainger, 1953)	Mean F.L. in.	5.1	5.5	6.8	11.9	13.3	14.3	16.3	16.7	19.0	20.1	21.8	21.9	22.0	23.7	24.1	25.6	25.3	25.9	26.7	26.7
Adlatok, Labrador	Mean F.L. in.	17.5	19.0	19.6	21.9	22.5	23.0	24.7	24.6												
(Andrews and Lear, 1956)	Mean wt. lbs.	2.2	2.9	3.0	4.4	5.0	5.7	6.1	6.1												

tween 1944 and 1954. The populations appear to have been local and declining catch per unit effort seemed to indicate that these local stocks were easily depleted.

The recognized angling record (Field and Stream Magazine) for arctic char is a 33¾ inch specimen taken in Finger Lake, Quebec, in 1959. It weighed 19 pounds, 15 ounces. Two previously unknown runs of anadromous Arctic char have been brought to our attention. Fishery Officer E. B. Motty reported an annual run of about 500 char in Middle Brook, Parsons Pond River. A specimen from this run angled by Mr. Motty on July 18, 1963, was forwarded to ROM. It was 504 mm in total length. Mr. Motty reported that 21 fish, taken from this group by anglers, ranged in weight from two to seven pounds.

Fishery Biologists Pratt and Cowley captured an Arctic char in the first pond of Caplin Cove Brook, Baie Verte Peninsula, on September 9, 1962. This population may also be an anadromous one.

This scene showing the river, forest and rocky nature of the terrain could be any one of scores of streams on the Island. The obstruction here, though difficult, would not form a complete barrier to Atlantic salmon upstream movement.
(*Photo courtesy V. R. Taylor.*)

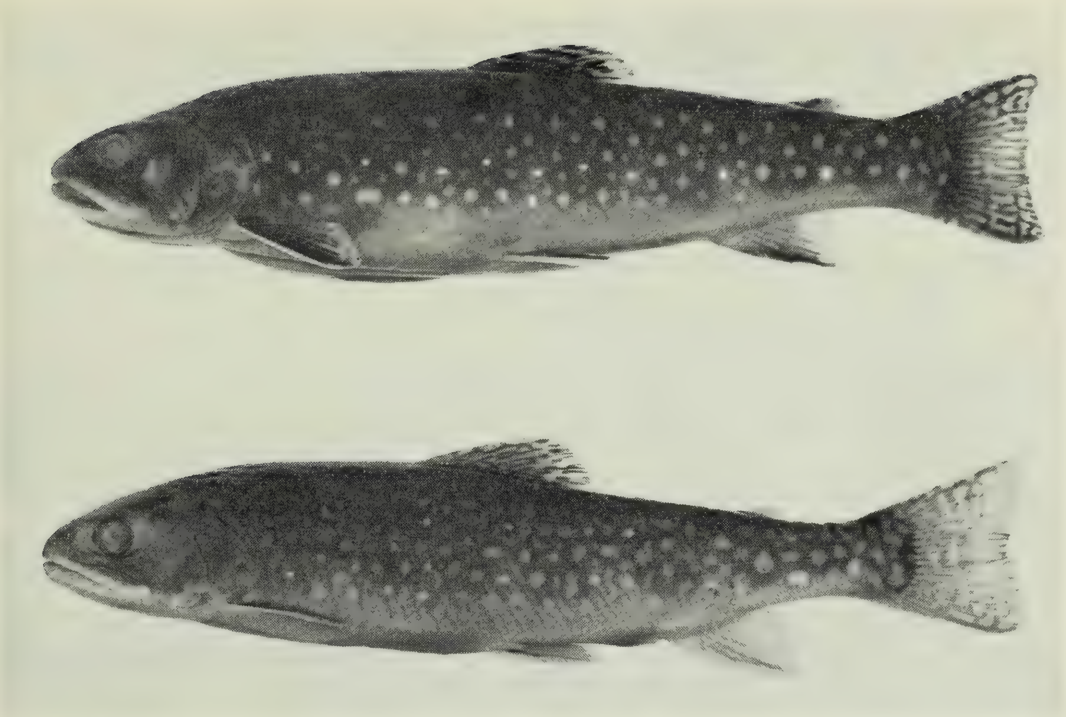


FIG. 8 Brook trout—freshwater or mud trout above, (ROM 21011; ♀; 247 mm. total length) searun trout below (ROM 20982; ♀ ; 240 mm. total length).

Brook trout *Salvelinus fontinalis* (Mitchill) 1815

Stations: 1, 2, 3, 4, 5, 6, 8, 9, 11a, 11b, 12, 13, 14b, 15, 18, 20, 22, 24a, 25, 27, 28, 30, 32.

Collections: 1, 7, 10, 12, 15, 17, 18, 19.

Other Common Names: anadromous form—sea trout; non-anadromous form—mud trout or native trout.

DISTRIBUTION

The often-used term of 'generally distributed' is nowhere so accurately applied to any fish as it is to the brook trout in Newfoundland. Rarely does one encounter a body of water, regardless of size, which does not contain one or more forms of this fish. It is so universal that it apparently occurs in all suitable waters on the island and to attempt to detail its distribution would be a folly. This trout is the most abundant freshwater fish in insular Newfoundland.

Of the station numbers listed above, 8, 9, 22 and 24 yielded sea trout and they were present in, but not taken from Station No. 6. The other collections were either undefinable or were definitely mud trout. It is probably safe to say that there are anadromous runs of sea trout in most or all of those rivers scheduled for salmon, and probably in some others as well.

In North America this species is found from Newfoundland westward to the Nelson River in Manitoba south to Minnesota and southward into Georgia along the Appalachian Mountains. There are sea run populations in maritime situations over the whole of the northern segment of its range.

MUD TROUT OR NATIVE TROUT—NON-ANADROMOUS BROOK TROUT

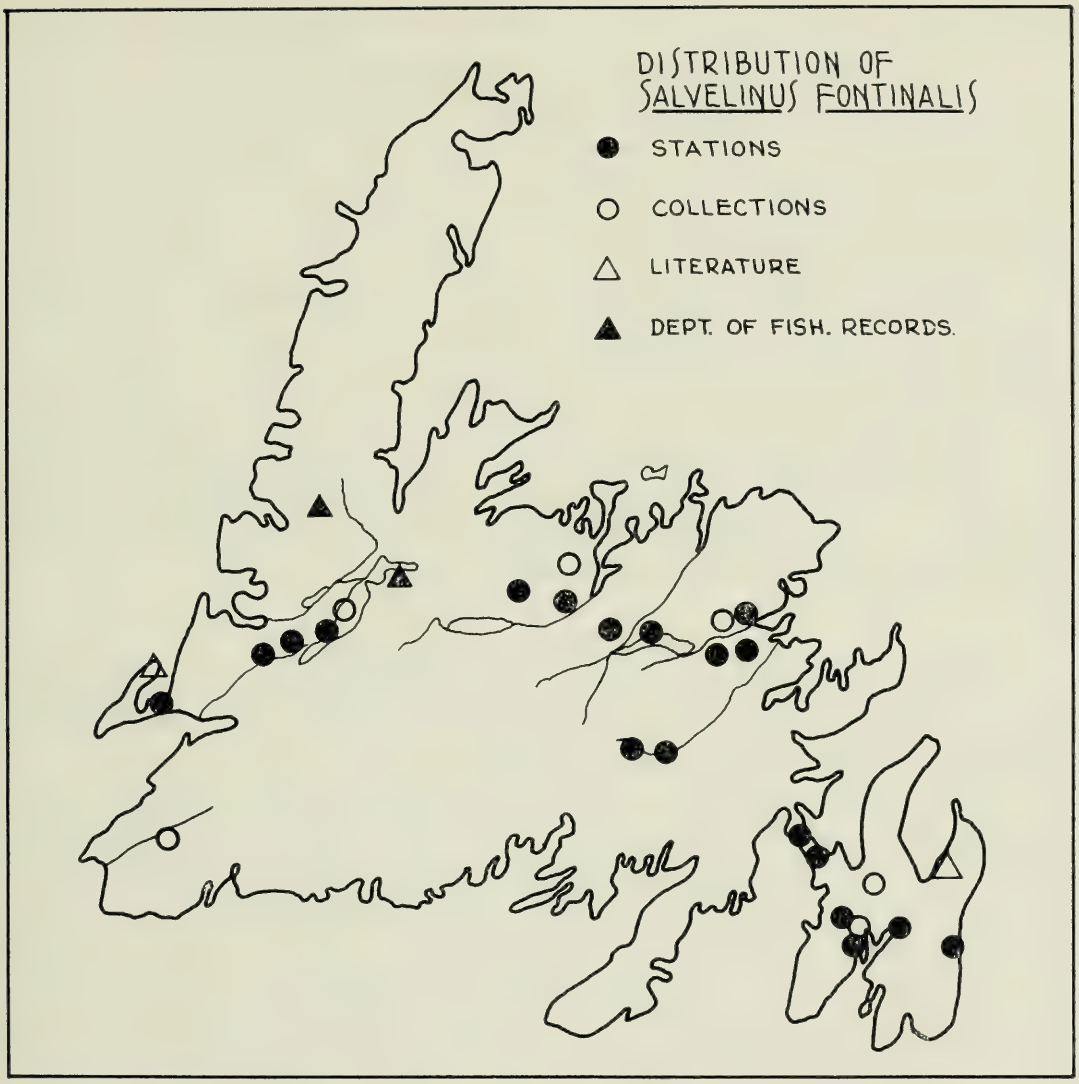
DESCRIPTION

The mud trout, or native trout as they are often called, are very brightly coloured—the colour varying with size, sex and habitat. The back may be brown through green to almost black. This area and the dorsal fin are strikingly marked with cream coloured wavy vermiculations. The sides are brown to green and liberally marked with light pink or yellow spots. Eight to ten dark parr marks are visible and there are red spots between the parr marks along the lateral line. The belly can be white to yellow in females or deeply coloured orange to red in males. The lower fins have a very characteristic pattern. The leading edge is milk white, this is followed by a black line and the remainder of the fin may be dusky to orange. It is only in the spawning season that there is sufficient difference in the colour of males and females to enable one to tell them apart.

While flesh colour of mud trout is variable, Wilder (MS) stated, in nonspawners, it changes with size. Trout under six inches have white flesh, those 6-9 inches have pale to orange and the flesh is deep orange in trout 10-14 inches. This change is probably correlated with habitat and food. The smallest trout are taken in small brooks, the medium size in larger streams and ponds, and the largest in large ponds and lakes. The flesh colour of trout is deepest in waters containing abundant crustaceans for them to feed on. These crustaceans are more available in larger bodies of water.

SPAWNING

Brook trout are fall spawners, the date varying with water temperature and flow. Frost (1940) gave the limits of the spawning season at Murray's Pond (near St. John's) in 1938 as October 15 to November 18. During this time water temperature ranged from 9° to 3.5° C. (48° to 38° F.). If suitable streams are available brook trout move into them to dig nests or redds in coarse gravel in shallow, fairly swiftly flowing streams or gravel which has ground water or springs seeping through it. If a pond or lake has no inlet or outlet streams they will spawn on gravelly shoals or shores if ground water or spring flows are present. It is usually only in the total absence of any suitable spawning



conditions that a pond will require stocking to maintain the population. Where there are spawning runs into streams the males run first, battle over the best territories and attract females when they in turn enter the streams. The females dig the redds and cover them after the eggs have been laid and fertilized.

The smallest trout seen on the spawning grounds at Murray's Pond was 5.4 inches (Frost, 1938a). At least 50 per cent of male and female mud trout are capable of spawning at age III (6-7 inches). According to Frost (1938a), the colour of the eggs of Newfoundland mud trout varies from pale yellow to orange and the size from 0.13 to 0.2 in diameter. Egg number varies from about 80 in a five inch female to 5000 in one of 22 inches.

Mud trout after spawning apparently recover in 2 to 2½ months if food is available. Fish which had spawned in October-November 1937 were in excellent condition on January 28, 1938 (Frost, 1940).

FOOD

Frost (1940) reported that for the greater part of the year the chief foods were amphipods (*Hyallela* and *Gammarus*), aquatic insect larvae (dragonfly, damselfly, midge and caddice), beetles, beetle larvae, worms and molluscs (*Planorbis*). During periods when rains or floods wash them into the water, wood lice, ants and other small land arthropods are often gorged on. Plankton is eaten to a lesser extent even when it is abundant. There appears to be no food selection. Cannibalism occurs but usually only where food is scarce. Males, during the spawning period, have exhibited a habit of feeding on trout eggs. Winter food would appear to be mainly amphipods, and Frost (*ibid*) reported the stomachs of mud trout caught in January to March in Murray's Pond were often distended with them. In some habitats where oxygen is lowered in warm shallow water in August, they feed very little, spending most of their time seeking oxygen-rich currents.

GROWTH

Growth is variable and depends on food and habitat. Larger and warmer streams produce trout which tend to grow faster and mature at larger sizes than do the small brooks.

The largest brook trout on record is one of 14½ pounds from the Nipigon River, Ontario. It may have, however, been utilizing Lake Superior in a pseudo-searun existence, hence its large size. According to Frost (1940) the largest mud trout from Newfoundland was one of 4 pounds, 1 ounce. Mud trout of a pound or a pound and one-half are considered large. The seven pound weight, for an individual referred to by Kennedy (1905) as *Salmo fontinalis,* may refer to a sea trout although he deals with sea trout separately. The average fork length of a sample of seven, taken in 1960 by gill net, from Lake St. George (Sta. 14b), was 221 mm. (8.7 in.), and that of 28 angled from Oliver's Brook, a small tributary to Gambo Lake (Sta. 22), was 185 mm. (7.3 in.). Frost (*ibid*) gives the following sizes for mud trout from Murray's Pond and Long Pond, Bay Bulls in September 1937: first year fish (0+) 48-52 mm.; second year fish 76-97 mm.; 180 from spawning beds (3 to 5+ years of age?) 135-305 mm. with the greatest number between 170 and 200 mm.

Growth data calculated for the two 1960 stations mentioned above exemplifies the direct relationship of growth rate with habitat area. There is a steady increase in growth rate of mud trout from brook to pond to lake (see Fig. 9). The age-length relationship and sex ratio of the 1960 material are shown in Table 12. The line for Murray's Pond was calculated from Frost's (1940:11) length frequency figure.

Wilder's (MS) data for Moser River, Nova Scotia mud trout shows that this large river population grew more slowly than Newfoundland trout in the early years but exceeded them in the older years. Growth

Table 12. Age-length relationship and sex ratio in a lake and a brook population of mud trout

ST. GEORGE'S LAKE (7 gill net fish)

Age		1	2	3	4	5	6	Totals
No. of trout					3	3	1	7
Sex Ratio	♂				2	1	1	4
	♀				1	2	0	3
Fork Length in mm.	Range				189–208	189–280	267	
	mean				198.0	229.3		

OLIVER'S BROOK (13 angled fish)

Age		1	2	3	4	5	6	Totals
No. of trout				3	3	5	2	13
Sex Ratio	♂			1	2	5	2	10
	♀			2	1	0	0	3
Fork Length in mm.	Range			142–143	163–188	198–237	219–232	
	mean			142.5	176.7	212.0	225.5	

of trout in some of the small brooks given by Wilder was far less than that for the Oliver's Brook population. Analysis of the scales showed that the smaller trout from Oliver's Brook exhibited uniform moderate to good growth in all years. Those from Lake St. George showed good growth in the early years but small growth in the older years. This and the comparison with Nova Scotia trout further emphasizes the effect in Newfoundland of the relative abundance of food for small trout but the scarcity of larger food which older trout could utilize to grow to greater size.

See Frost (1940:11) for some parasites of mud trout in Newfoundland.

While the mud trout is the smallest and least esteemed of the salmonids it is the most abundant and constantly available. It therefore, no doubt, supports to a considerable extent the angling pressure of the general resident anglers.

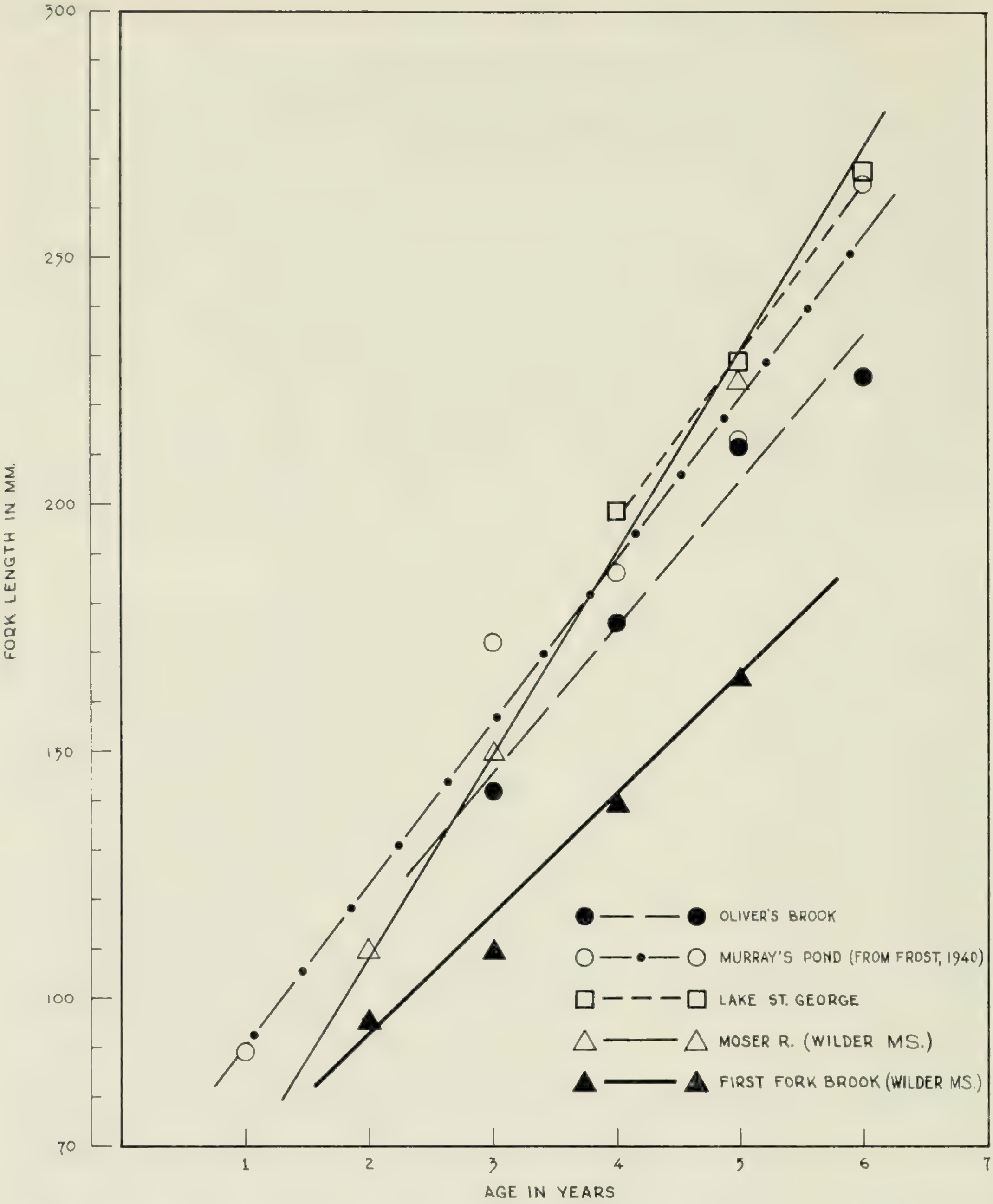


FIG. 9 Age-length relationship of Newfoundland populations of mud trout from various sized habitats compared with Wilder's (1940) Nova Scotia data.

SEA TROUT—ANADROMOUS BROOK TROUT

For extensive coverage of the life history of this form and comparisons of freshwater and sea trout in other areas, see the following: Smith and Saunders (1958); White (1940, 1941, 1942); Wilder (MS, 1952); Wilmott (1877).

DESCRIPTION

In contrast to the gay pattern of the mud trout, the sea trout, when it enters freshwater is more salmon-like in its colouration. The back is steel blue to metallic green and without obvious vermiculations. The sides are silvery and marked only with somewhat larger pink, yellow, pale orange or greenish spots, no bright red spots or parr marks are apparent. The belly is white. The lower fins have the milk white leading edge but not the black line or other bright colours All fins are of a dusky hue and unmarked. However, by September sea trout which remain in freshwater cannot be distinguished from mud trout by colour alone (Wilder 1952, Wilmot 1877). Wilder (MS) reported that known nonmigratory populations in Nova Scotia were, in spring, quite silvery and closely resembled sea trout.

Flesh colour in sea trout also varies. According to Wilder (MS), small trout descending to the sea for the first time have white or pale flesh, while in the sea the flesh is orange to deep orange. When these fish return to freshwater flesh colour gradually pales as the body colour changes.

Sea trout soon after returning from the sea are much fatter than mud trout and it was observed that the body wall was much thicker. In addition to colour differences it was noted at the time of capture (23 July 1960) of a sample from Oliver's Brook, Gambo Lake, (Station 22) which contained both sea trout and mud trout, that the sea trout appeared to have longer pectoral and ventral fins than did the mud trout caught in the same pool. A simple comparison of the mean of two proportions for nine individuals of each type in the size range 172-207 mm. T.L. showed the following:

	Mean Pectoral Length	Mean Ventral Length	$\frac{\text{Total Length}}{\text{Pectoral Length}}$	$\frac{\text{Total Length}}{\text{Pelvic Length}}$
mud trout	26.22	20.8	7.15	9.02
sea trout	24.81	20.63	7.88	9.45

Comparing only actual measurements of fins those of mud trout appear slightly longer; however, when proportional measurements, taking body length into consideration, are made, the fins of the sea trout in this July sample were longer. According to the migratory dates of sea trout and the ages of these individuals they should have been "freshrun" sea trout. If this is so then this difference is in direct contrast to Wilder's (MS) data for Nova Scotia sea trout. He said, "Fresh run sea trout have comparatively small head parts and fins" [in comparison with mud trout]. Backus (1957) on the other hand comparing nonanadromous *S. fontinalis* with a third form (estuarine trout or "slob") in Labrador, described a size difference similar to that which Wilder (MS) gave for his comparison of Nova Scotian sea trout and nonanadromous trout. Wilder's analyses showed that *mud trout* in June and July had *larger* fins but by August and September the development in sea trout, of secondary sexual characteristics brought the proportions of the two types closer together. He postulated that annual changes in fin size in adult fish are secondary sexual characteristics. This difference could, however, be accounted for as he said (1952:196), "The average . . . difference in body form between . . .sea trout and . . . freshwater trout was less than that between two lots of trout of common parentage reared at different temperatures."

Table 13 gives the number of pyloric caeca and gill rakers in the samples of mud trout and sea trout from Oliver's Brook. There is a difference both in the range and mean values for pyloric caeca in these two types of speckled trout, mud trout having, on the average, 5 more caeca. It would be interesting to speculate on the role of diet in the sea in affecting this difference in the surface area of the gut. Degree of genetic fixity in this structure is not known but the samples contained comparable ranges of sizes and there appeared to be no correlation between caeca number and length of fish.

When the usual count of gill rakers (including the pad-like rudiments at the end of each limb) for mud trout is compared with that for sea trout there is no great difference. Nor do the Oliver's Brook counts differ greatly from figures for these two forms in the Moser River, Nova Scotia (Wilder, 1952). Increasing the sea trout sample size to equal that of the mud trout does not alter this. The Oliver's Brook data also fit within the range for various populations in eastern Canada given by Wilder (MS).

When, however, only developed gill rakers (those with some significant vertical height above the arch, and which can be moved from side to side) and not the rudiments are counted, the mean difference between the sea trout and mud trout is 2.2 rakers and there is little overlap in frequency distribution. Adding data for sea trout from Port au Port (Station 9) to make equal sample sizes in mud trout and sea trout narrows the difference and testing the two frequencies shows no significant difference. While gill rakers exclusive of rudiments seem superficially to bear out the difference shown in pyloric caeca, closer analysis shows no real difference between sea trout and mud trout in this character.

Table 13. Comparison of the number of pyloric caeca and gill rakers in samples of sea trout and mud trout taken from the same waters

PYLORIC CAECA

Oliver's Brook, Newfoundland (Station 22)	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	Mean	No.	Total Length
sea trout		1	1			2	1	2		1	1						36.78	9	173–200
mud trout									3	5	2	5		3	1	1	41.60	20	155–250

GILL RAKERS

Location	Upper Limb					Lower Limb			Total									
Oliver's Brook, Newfoundland (Station 22)	4	5	6	7	Mean	11	12	Mean	14	15	16	17	18	19	20	21	Mean	No. of Fish
sea trout	1	2	4	2	5.78	4	5	11.55		1	1	3	2	2			17.33	9
mud trout	2	12	4	3	5.38	17	4	11.19		2	10	5	3	1			16.57	21
Moser River, Nova Scotia (Wilder, 1952)																		
sea trout									1	10	31	53	42	28	6	—	17.36	171
mud trout									2	14	35	35	33	20	10	1	17.25	150

ANNUAL MOVEMENTS AND SPAWNING

The spawning habits, other than the ascent from the sea, and early life in freshwater of sea trout does not differ greatly from that of the mud trout. Spawning time is the same fall period. Fry hatch in February and emerge from the gravel in early April (Wilder, MS); as they grow they tend to move into larger bodies of water (larger rivers and lakes) where they often remain during their second and third years.

Sea trout descend to the sea in late April to early June. The run is strongest when stream temperature approaches 50°F., a drop in temperature retards or even reverses part of the run (White, 1941). Some trout move down every month of the year and there is a second peak run in October to December in Prince Edward Island (Smith and Saunders, 1958). The run consists of small trout (age III and age IV White, 1940; sometimes age II in Newfoundland) descending for the first time, or larger fish which spawned the previous fall and sexually immature large fish which ascended but did not spawn the previous fall. They do not necessarily move every year from freshwater to salt (Wilder, 1952). They move out of the inner estuaries quickly and in May and June are roving the shores in 5-10 ft. of water (White, 1942) in schools of 5-20 fish. They are now very silvery and easily distinguishable from mud trout caught at the same time in the rivers and brooks.

Most sea trout return to the river during July of the year they descended (June-August) and have remained in the sea an average of two months (White, 1941). Smith and Saunders (1958) reported ascents in April to July and again in November. As the season advances sea trout continue farther upstream. Some must move directly to the brooks as those caught in Oliver's Brook late in July were at least 10 miles from the sea at that time.

Less than 50 per cent of female and male sea trout approach sexual maturity at age III. However, 90 per cent of the fish of age IV in the run are spawners. They must reach at least 200 mm. before half are ready to spawn (Wilder, MS). Wilder (MS) claimed that 70 per cent of those migrating to the sea were females. Sex ratios of samples of sea trout taken in Newfoundland freshwater were:

Station 9—Piccadilly Bay—12 ♀♀ : 9 ♂♂
Station 22—Oliver's Brook—7 ♀♀ : 2 ♂♂
Collection 7—Little Codroy River—4 ♀♀ : 4 ♂♂

FOOD

Food in the sea consists principally of fish. According to White (1942) those on the Nova Scotia coast feed on squirrel hake—*Urophycis chuss*, American eel—*Anguilla rostrata,* sea raven—*Hemitripterus americanus,* mummichog—*Fundulus heteroclitus,* rock gunnel—

Pholis gunnelus; such crustaceans as *Crago septemspinosus, Mysis stenolepis* and *Gammarus sp.* and sand worms—*Nereis sp.*

Food selected depends on what is most readily available and these or other small shore fishes no doubt form the food of sea trout in the sea off the Newfoundland rivers.

On returning to freshwater, sea trout apparently stop feeding for some time. The physiological readjustment to freshwater and sudden absence of the larger food they have been utilizing probably accounts for this. However, the fact that they will take food in captivity and that they strike at anglers' artificial flies indicates some ability and willingness to take food when in freshwater. When they do begin to feed in freshwater their food will be similar to that of the mud trout—insects, amphipods and possibly small fishes including other trout.

GROWTH

Partly as a result of the annual opportunity for feeding in the sea on larger more abundant food for even so short a period as two months, sea trout in the same lifespan achieve much greater ultimate sizes than freshwater brook trout. There are reports of sea trout of seven pounds from Alexander Bay, eight and nine pounds from Deer Harbour. A record sea trout was apparently landed in 1908 when fish of 10¾, 12 and 15 pounds were taken from the Fox River and Romaine's Brook. The largest, from Romaine's Brook, was 31½ inches long and 8½ inches deep (Morris, 1937). The large size of this fish would suggest it might have been a sea run brown trout rather than a sea trout. However, there is no present day record of brown trout from this area and it is known that it produces large sea trout. Department of Fisheries records show that in 1941, Chief Protection Officer H. V. E. Smith took from the Serpentine River twenty-three sea trout none less than two pounds and one slightly over seven pounds. Wilder (MS) records a maximum of 19⅛ inches and 3¾ pounds for the Moser River in Nova Scotia.

The early growth, before first descent to the sea, is apparently similar to that for mud trout. The variability of growth from habitat to habitat is great. There were too few sea trout in the samples to separate habitats in analysis of growth. Table 14 gives the age-length relationship and sex ratio of the total sample of 10 from Piccadilly Bay, 9 from Oliver's Brook and 8 from the Little Codroy River. Sea trout from Piccadilly Bay appeared to grow the fastest and those from Oliver's Brook the slowest. Other than one individual, from Little Codroy River, six years of age and 255 mm. F.L., maximum age appeared to be five years.

Time spent in fresh and saltwater is variable as is age of first descent. These two factors probably determine ultimate size of sea trout in any population.

A typical scene on the lower part of Indian River—a good producer of small Atlantic salmon. The last several miles of the course of this river are quite gentle and meandering.

From an analysis of scales it would appear that most sea trout in the Little Codroy River go to sea first in their third year and return there each year for two years. However, some may remain in freshwater for a year or more after first ascent before descending to the sea again (*see* Table 15). Piccadilly Bay sea trout were similarly irregular in movements to and from the sea. The population in Oliver's Brook appeared more uniform. They spent three years in freshwater before going to sea and then returned to the sea in each of the two remaining years.

Next to Atlantic salmon sea trout are the favourite quarry of resident and visiting anglers in Newfoundland. Limit catches are often attained during the ascent into freshwater particularly when high tides flood the streams making their passage farther upstream possible. At this time they provide exciting sport to fly fishermen as the main runs

Table 14. Age-length relationship and sex ratio of total sample of 27 sea trout from Piccadilly Bay, Oliver's Brook and Little Codroy River

Age		1	2	3	4	5	6
No. of trout				7	11	8	1
Sex	♂			2	2	5	1
Ratio	♀			5	9	3	—
Fork Length in mm.	Range			111–164	173–255	180–255	255
	Mean			136.29	196.55	212.50	—

Table 15. Growth in freshwater (F) and saltwater (S) of eight sea trout from Little Codroy River

Age at Capture	Size at Capture F.L. mm.	Growth History
4	208 ♀	1, 2F; 3, 4S
	255 ♀	1, 2, 3F
5	180 ♂	uniformly small
	203 ♂	1, 2F; 3, 4, 5S
	211 ♀	1, 2F; 3S; 4F; 5S
	213 ♂	moderate uniform growth in all years (?)
	255 ♀	1, 2F; 3, 4S; 5F
6	255	1F; 2, 3S; 4, 5, 6F (?)

are in scheduled rivers. These beautiful fish are often clearly visible in large numbers in the lower, deep, clear, pools of the rivers. They are congregated there awaiting the next flood to move upstream. Sea trout are also taken angling off wharves and by trolling along the sea shore during the periods when they are at sea.

There is probably a third or estuarine form of brook trout which live mainly in the estuaries and river mouths and which go in and out of the lower reaches of the rivers with the tides. Their growth rate is intermediate between that of mud trout and sea trout. These trout are called "slob" in Labrador (Backus, 1957).

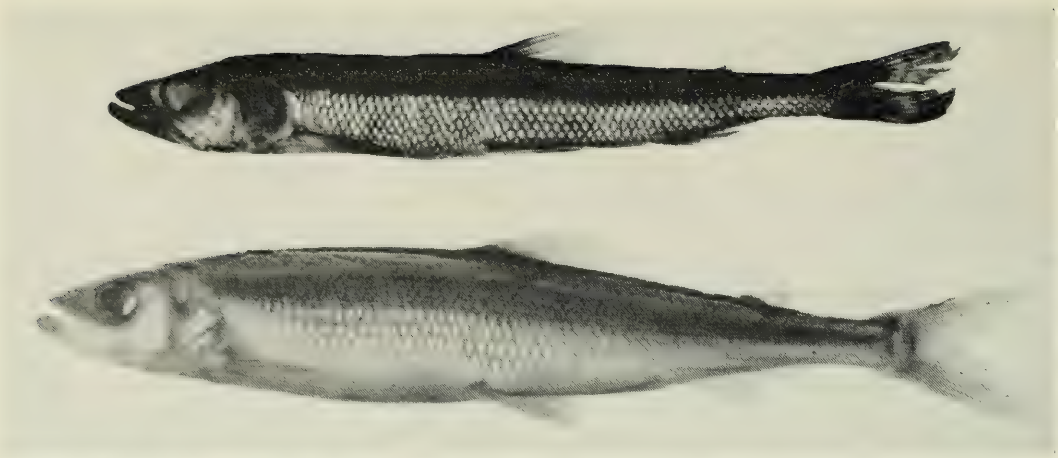


FIG. 10 American smelt—dark, densely pigmented, landlocked smelt above, (ROM 21008; ♂; 186 mm. total length) searun smelt below. (ROM 20983; ♀; 255 mm. total length)

American smelt *Osmerus mordax* (Mitchill) 1815

Stations: 9, 20, 30.

Collections: 1, 7, 17.

The American smelt occurs both in salt and freshwaters in Newfoundland. Although the sea-run or anadromous populations are the better known the smelt also occurs in a number of lakes. In some of these it is migratory, going to sea and returning to freshwater at will, but in a number of lakes it is a permanent resident, being unable to gain access to the lake from the sea because of steep gradients (waterfalls) in the connecting rivers. Smelt in lakes of this type are said to be landlocked. Although they may be able to leave the lake by going over the falls and hence down to sea, they cannot make the return trip. Many Newfoundland lakes contain landlocked smelt; those known to us are listed below. We are advised that smelt eggs were imported from New York State in 1893 and 1895 and planted in some Newfoundland lakes.

Newfoundland lakes known to contain landlocked smelt:

Lake	*Drainage*
Gull Pond	Salmonier River, St. Mary's Bay
Butt's Pond	Freshwater Bay, Bonavista Bay
Deer Lake	Humber River System
Terra Nova Lake	Terra Nova System
George's Pond	Terra Nova System
John's Pond	Terra Nova System
Gander Lake	Gander River, Gander Bay

Landlocked and sea-run or anadromous smelt sometimes differ from each other in a number of ways. The landlocked form seldom attains the size or plumpness of the sea-run smelt, tending instead to be somewhat more slender and darker in colour. (These characteristics do not apply to the introduced smelt in the Great Lakes.) The darkness is due to the presence of large numbers of black pigment spots or chromatophores, especially around the head. Such features are also characteristic of indigenous or landlocked smelts occurring in Quebec. Landlocked smelt often go undetected in a lake for years after it has been regularly fished by anglers for other species. In such situations it is most frequently found washed upon shore, usually on a sandy beach and quite often after a storm. Personnel of the Fisheries Research Board in Newfoundland have reported finding smelt in this manner in Gander Lake and George's Pond.

Throughout its range along the Atlantic coast, the smelt is normally an anadromous species ascending streams and rivers above the level of tide to deposit the adhesive eggs on the stones and gravel of the stream bottom. Spawning occurs early in the spring and in some regions, such as New Brunswick's streams flowing into the Gulf of St. Lawrence, the smelt aggregate in the estuaries in the fall, remain there all winter and ascend streams in the spring to deposit eggs and sperm. This habit of gathering in large numbers in estuaries in the late fall and remaining throughout the winter has made possible the establishment of successful commercial fisheries, as for example in New Brunswick, where special trap nets are set beneath the ice to catch smelt.

Smelt also take a baited hook readily, especially in winter, and a casual fishery is carried on. In addition to angling, sea-run smelt are caught in commercial quantities by gill nets in the fall of the year, mainly in the Bay St. George region of the west coast and in the Notre Dame Bay region of the northeast coast. The quantity landed in 1960 was 109,000 pounds.

The northernmost limit of range of smelt on the Atlantic coast of Canada has been established by the reports of Low (1895), Backus (1957) and others who have recorded captures in the Hamilton Inlet-Lake Melville estuary of Labrador (about 54°00′ North latitude).

Henry Reeks (1871) in an article published in the Zoologist wrote the following account of Newfoundland smelt (which he called *Osmerus viridescens*): "As soon as the ice disappears in the spring these little fish ascend the smaller streams in 'countless thousands,' and become an easy prey of bears, gulls, trout, etc. The smelt possesses a strong smell, resembling that of cucumbers, and probably this peculiar odour may be obnoxious to some of its would-be enemies, for I had a specimen of the American roughlegged buzzard, *Archibuteo Sancti-Johannis* (Gmelin), which I fed chiefly on trout (*S. fontinalis*), and of which it seemed particularly fond, but it would not eat smelts, either dead or alive, even when almost starved to do so."

In the Annual Report for 1932 smelt were said to occur in Newfoundland in numbers in the rivers of Notre Dame Bay, Humber River mouth, and Port au Port Bay. Jeffers (1932) wrote that a few were seen each summer of 1927, 1929 and 1930 around the wharves at Raleigh but that they were never abundant and that they were not fished commercially. Doubtless smelt occur in most suitable bays and estuaries around the island.

Smelt may be subject to marked changes in abundance, a characteristic of many fish populations. Mr. Thomas Curran in a letter written in June 1957 remarks that smelt of 2 to 3½ inches in length swarm in the spring in the stream mouths of certain rivers of Gambo Pond (Lake) and notes further that only in recent years have smelt been found in 2nd Gambo Pond. He also commented that these fish were almost always uniform in size but that fish measuring up to 12 inches in length were caught only in quite recent years and but one or two each spring.

From Station 9, Port au Port Bay, a sample of 45 specimens were retained from a much larger number taken by seine. The length distribution and sex of this sample is shown in table 1. Notice that the males outnumber females by about 3:1, and that the females average larger than the males. This size difference between males and females is characteristic for smelt in the Great Lakes region also.

Table 16. Size range and sex of a sample of American smelt from the estuary of a small stream in the Port au Port Bay region

Total Length Range — mm.	♂♂	♀♀	Total
120–129	1	—	1
130–139	1	—	1
140–149	1	—	1
150–159	—	—	—
160–169	1	—	1
170–179	3	—	3
180–189	9	—	9
190–199	8	—	8
200–209	4	6	10
210–219	4	6	10
220–229	1	—	1
Totals	33	12	45

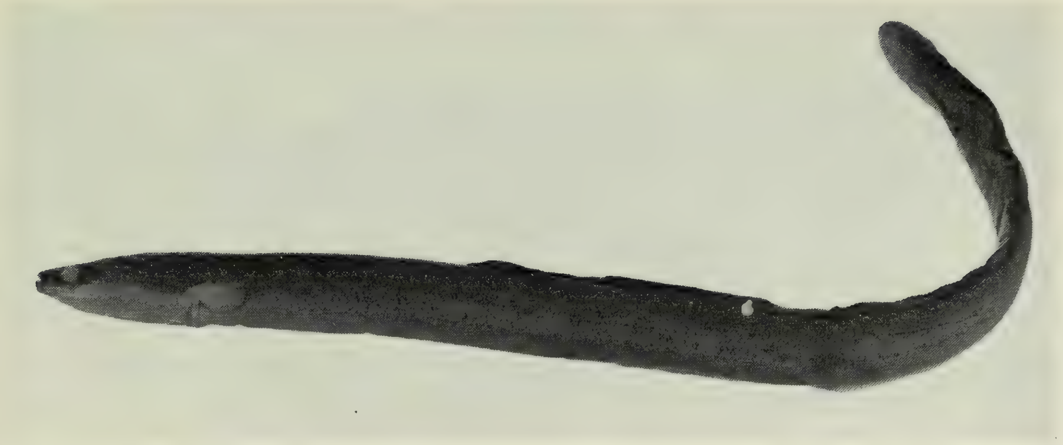


FIG. 11 The American eel—common in many Newfoundland rivers and lakes. (ROM 20970; 264 mm. total length)

American eel *Anguilla rostrata* (LeSueur) 1817

Stations: 4, 25.

Collections: 7.

While Newfoundland is not the northern limit of range for the eel, it is the northeasternmost region in North America where the species commonly occurs in large numbers. Backus (1957) recorded the first positive record for Labrador, demonstrating that specimens were taken in the Hamilton Inlet-Lake Melville estuary. Jensen (1937) reported the occurrence of six specimens in streams of southwestern Greenland, ranging in size from 109 to 660 mm. total length, caught over a period of 79 years, from 1841 to 1920.

The eel is common in the streams and rivers of Newfoundland but is not utilized even though the species is highly regarded as a food fish in western Europe and is enjoying increasing popularity in eastern Canadian cities. Various Newfoundland authors have lamented the failure to use this food source, for example, Macpherson (1937) noted ". . . in the case of eels, there must be a potential export industry." Again, Nancy Frost (1939) stated "At present Newfoundland's plentiful stock of this food fish is quite ignored except by a very limited number of people."

The total lengths of the specimens gathered in the course of the present study are as follows: Station 4 (ROM 20972) 194, 256, 261, 276, 351, 492 mm.; Station 25 (ROM 21019) 115 mm.; Collection 7 (ROM 21041) 177, 228, 282, 554, 556, 622 mm.

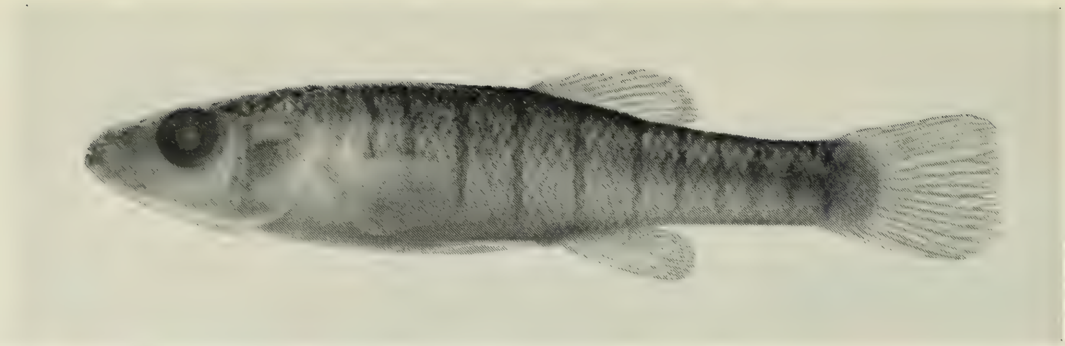


FIG. 12 The banded killifish is closely related to the mummichog but more restricted in distribution (ROM 21979; 51 mm. total length)

Banded killifish *Fundulus diaphanus* (LeSueur) 1817

The banded killifish was first reported to occur in Newfoundland waters in 1951. The Annual Report of the Newfoundland Fisheries Research Station for 1951 (pp. 51-52) under the title, New or Unusual Records of Fishes, contained the following: "A new record for Newfoundland is *Fundulus diaphanus diaphanus.* Four mature females of this species, with the eggs beginning to clear, were taken in brackish water at Stephenville Crossing, St. George's Bay, June 11, 1951."

During the current study *F. diaphanus* was taken at only one place, Station 10, in association with *Fundulus heteroclitus.*

F. diaphanus is a common species in nearby Nova Scotia, where its range extends northward to include the coastal waters of Cape Breton Island (Livingstone, 1951). The species also occurs on Prince Edward Island where it has been shown to hybridize with *heteroclitus* (Hubbs et al, 1943). The present samples show no evidence of hybridization although there is little doubt but that the two species occur together. The collection from Station 10 consisted only of *Fundulus,* 89 specimens of *F. diaphanus* and 152 of *F. heteroclitus.* The collection was made along a 50 yard section of freshwater stream having very obvious tidal influence in the downstream portion of the area sampled. The collection was made on 14 July 1960 and there was no evidence of spawning activity, nor did any of the females contain ripe eggs, as was the case in the sample taken in 1951, and it is assumed that spawning occurs in June.

A morphometric comparison of the two species is given in table 17. Lateral scales and gill raker counts were found to be particularly useful characters for distinguishing the two species. Dorsal fin ray counts and a combination of pre-dorsal and post-dorsal body lengths were also useful. This latter character is an expression of the difference in the position of the dorsal fin in the two species. If the distance from origin of dorsal fin to end of vertebral column is subtracted from the distance of the origin of dorsal fin to snout, a figure is obtained, which we will name "dorsal fin index" (*see* table 17). Dorsal fin index is correlated with size and hence, although some overlap is indicated at the value of 7 in table 17, this occurred for *heteroclitus* under 35 mm standard length but those *diaphanus* with this value were in the 50 mm size range (our largest specimens). That is, the values for dorsal fin index begin to approach each other when small *heteroclitus* are compared with large *diaphanus*.

Mention must be made of a news release in September 1962 by the Canadian Press concerning the capture of a new species of fish from Newfoundland waters. Typical of the newspaper articles was that appearing in the Niagara Falls Evening Review for October 5, 1962, which read as follows: "Rare Fish Found in Nfld. Pond—St. John's, Nfld. (CP)—A species of fish never before reported east of Montreal in Canada has been found in a small pond on Newfoundland's west coast.

"The find was reported this summer by the biology department of Memorial University here which says attempts are being made to find more of the rare fish.

"One specimen of the *Umbra Lima*—a species of mud minnow—was found in Noels Pond on the Ernest Harmon United States Air Base by U.S. divers working voluntarily with the university in its marine studies."

Harry's River in southwestern Newfoundland. A salmon river well known to anglers.

The specimen in question, kindly sent to the authors from Newfoundland, proved to be a female *Fundulus diaphanus,* and not *Umbra limi* as erroneously reported by the newspapers. There is, of course, no evidence for the occurrence of the mudminnow, *Umbra limi,* in Newfoundland waters. The report, however, does indicate that *F. diaphanus* occurs in Noel's Pond, a freshwater pond on the grounds occupied by the United States Air Force Base, and in the same region (head of Bay St. George) as the specimens previously taken.

These three are the only Newfoundland records for *F. diaphanus* known to us and all were for specimens taken within a few miles of Stephenville Crossing.

Table 17. Comparison of morphological characters of "Fundulus diaphanus" and "F. heteroclitus" from Station 10, Stephenville Crossing, Newfoundland

Species	Scale Rows																	
	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	N	Mean
F. heteroclitus	4	2	12	9	8	1	1										37	34.6
F. diaphanus									1		3		2	6	2	1	15	44.2
	Dorsal Fin Rays																	
	11	12	13	14	15													
F. heteroclitus	10	20	2														32	11.7
F. diaphanus			9	5	1												15	13.5
	Gill Rakers																	
	4	5	6	7	8	9	10	11	12									
F. heteroclitus					1	14	10	7	1								33	9.8
F. diaphanus	1	11	3														15	5.1
	Dorsal Fin Index																	
	4	5	6	7	8	9	10	11	12	13								
F. heteroclitus				1	5	5	4	7	6	2							30	10.2
F. diaphanus	2	6	4	3													15	5.6

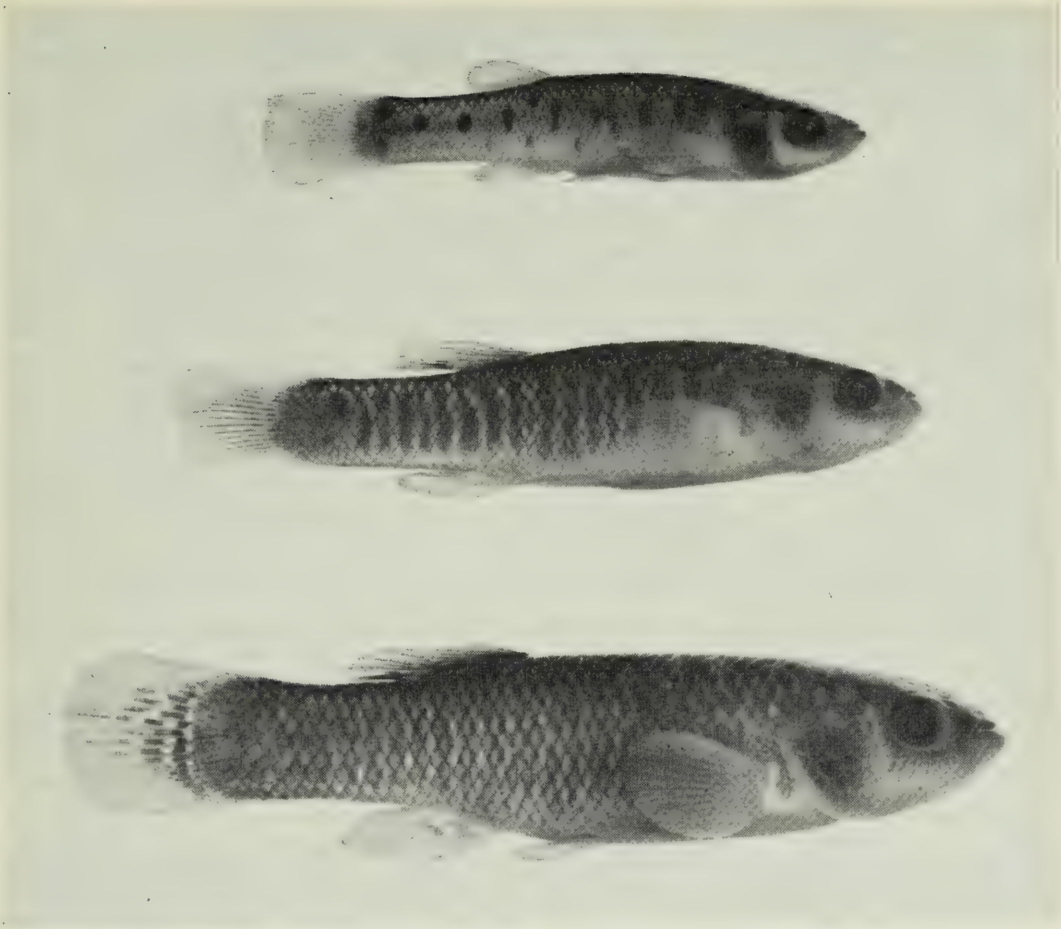


FIG. 13 Mummichog, *Fundulus heteroclitus*, showing three typical colour patterns. (ROM 20991; ♀; 46 mm. ROM 20991; ♂; 59 mm: ROM 20986; ♂; 74 mm. total length)

Mummichog *Fundulus heteroclitus* (Linnaeus) 1766

Other Common Names: barbel

Johansen (1926) published an account of the most northeasterly record for the mummichog on the basis of specimens collected by him in "Big Brook" near "Piccadilly", southern Port au Port Bay in southwestern Newfoundland. Records obtained during the current study indicate that the species is distributed in suitable localities along the southwestern corner of Newfoundland. This statement is based on specimens collected from the southern portion of Port au Port Bay (in addition to Johansen's record), the head of Bay St. George and from the Little Codroy River north of Port aux Basques. The size of the collections from Port au Port Bay (194 specimens) and the head of Bay St. George (152 specimens) suggests that the species is well established in Newfoundland waters and has a wider distribution than does *F. diaphanus*. There are no records of its occurrence in Labrador.

The northern limit of range of *Fundulus heteroclitus* has been variously misstated in the literature, principally it would seem because of Kendall's (1909) paper on the fishes of Labrador. Kendall included *heteroclitus* on the basis of two reports from Anticosti Island. There is a discrepancy here for Kendall's authority (p. 221) is "Schmitt, 1901, 1904", yet in his extensive bibliography we find "1901, Smith, J." and "1904, Schmitt, Joseph." The articles are respectively in English and French and we are left to speculate if these were written by the same man. Nevertheless, the record from Labrador as reported by Kendall was *not* from Labrador as defined by him in the introduction but from Anticosti Island which lies south of the 50th parallel in the Gulf of St. Lawrence. The Labrador report seems to have stuck, however, and Halkett (1913: 69) added to the confusion by extending the range to ". . . Anticosti Island, and Labrador:". Even in the last decade Miller (1955) in a review of the genus *Fundulus* reported the distribution of *heteroclitus* as "From Labrador (Kendall, 1909: 221; Halkett 1913: 69) southward. . .". Most authors have been content to report the range as did Livingstone (1951) "From Maritime Provinces south to South Carolina". In a general review of the genus *Fundulus,* Brown (1957) correctly interpreted Kendall (1909), and gave Anticosti Island as the limit of range. Thus Johansen's (1926) record seems to have gone largely unnoticed except by Bigelow and Schroeder (1953: 164) who give the Port au Port Bay record as the most northerly record known to them. Interestingly, some of the specimens collected by Johansen in 1922 found their way to the United States National Museum and five specimens of *F. heteroclitus* (US NM 86,223) labelled only "Newfoundland, Fritz Johansen" were examined by us and the data included in table 17.

Morphometric data for Newfoundland mummichog extend slightly the range of values previously reported (table 17). For example Hubbs *et al* (1943) working with Prince Edward Island specimens report scale rows, head to caudal, ranging from 34 to 36 with a mean of 34.8. Newfoundland specimens ranged from 32 to 38 with a mean of 34.6. Note that there is no overlap between *F. heteroclitus* and *F. diaphanus* in number of lateral scale rows. Brown (1957) employing 38 specimens from North Carolina and New York states gives a range for lateral line scales of 31 to 35, a distinctly lower range of values than that obtained from Newfoundland. Similarly Prince Edward Island specimens had a range in dorsal fin rays of 11 to 12, with a mean of 11.8 while Newfoundland specimens ranged from 11 to 13 but with a mean of 11.7. Here, however, some overlap does occur in the two species, 5% in the case of *heteroclitus* but 60% for *diaphanus.* Gill rakers are a most useful character for distinguishing the two species for the range of values do not overlap. Prince Edward Island specimens as published by Hubbs *et al* (*ibid*) showed a range of

9 to 12 with a mean of 10.1 gill rakers contrasted with a range for Newfoundland material of 8 to 12 with a mean of 9.8. The means for the three characters discussed above, i.e. lateral scale rows, dorsal fin rays and gill raker counts show good agreement with the values for Prince Edward Island specimens as noted above.

In the case of gill raker counts, the difference between the two species *diaphanus* and *heteroclitus,* is much greater than is evidenced by the number alone. For example *diaphanus* has rakers only on the lower part of the arch, none appearing above the angle on the upper portion whereas 29 out of the 33 *heteroclitus* examined had 1 to 3 rakers on the dorsal or upper portion.

Dorsal fin index (*see* under *F. diaphanus*) was also found to be a very useful character for distinguishing the two species showing no overlap in values when comparing fish of comparable sizes.

Subspecific designations in *Fundulus heteroclitus* should await publication of regional variations of the species as suggested by Brown (1957). The species is widely distributed along the Canadian Atlantic coast and southward but has received very little attention, particularly in Canada. The species is relatively small and easily obtained and could provide excellent material for experimental studies dealing with the salinity and temperature requirements of the species and also studies involving meristic variation.

Big Falls, Humber River—one of the most famous Atlantic salmon pools in North America. From 500 to more than 1,000 salmon are angled annually from this pool during the fishing season. (*Photo courtesy V. R. Taylor.*)

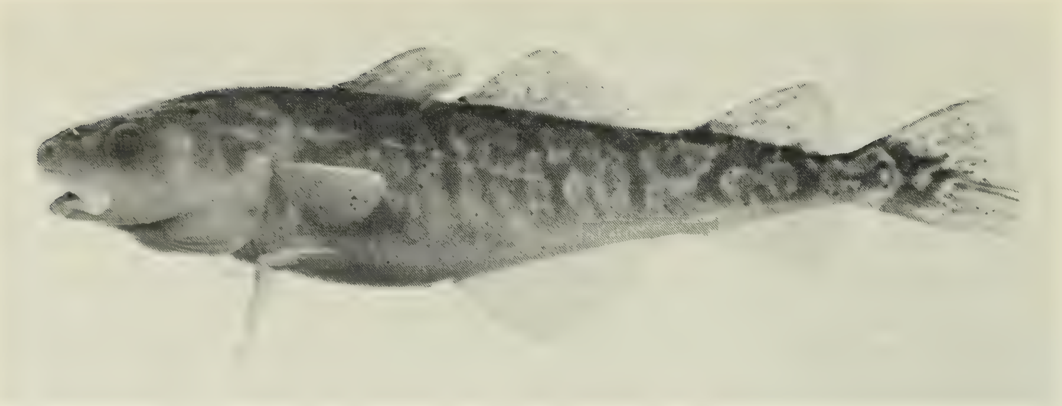


FIG. 14 The tomcod is landlocked in Deer Lake (ROM 21114; 190 mm. total length).

Tomcod *Microgadus tomcod* (Walbaum) 1792

Until 1962, a freshwater capture of tomcod had been reported only once from Newfoundland. This first report by Jeffers (1932) referred to a specimen taken from a stream flowing into Pistolet Bay at the northern end of the island. Jeffers also noted that the fish (locally called "snig") was abundant during the winter in Pistolet Bay. Frost (1938b) noted that the tomcod was commonly seen in salt water around wharves. However, in 1962, Department of Fisheries biologists engaged in routine field work, caught specimens in Deer Lake of the Humber River system.

The tomcod regularly enters fresh or brackish waters along the Canadian Atlantic coast. In the provinces of Nova Scotia, New Brunswick and Prince Edward Island it commonly moves into estuarial waters, at times ascending streams or rivers well above tidal influence into freshwater. Spawning takes place in the estuaries or lower portions of streams, in salt, brackish or even fresh water. In Lake St. John, Quebec, there is a landlocked population of tomcod, permanently resident in freshwater.

This fish is more abundant in brackish waters during the winter months, particularly during the spawning activities which occur mainly in December and January. Backus (1957) reports the species from Lake Melville, Labrador, and relates that it was reported to be common also in Lake Melville during the winter.

Although there are only these two freshwater records at present, it is quite possible that it occurs in other freshwaters in the province. In the St. Lawrence River (especially around Three Rivers) and other parts of its range along the east coast, the tomcod provides a winter sport fishery of some importance. It readily takes a baited hook and the flesh has a fine flavour.

THE STICKLEBACKS *Gasterosteidae*

This group of largely euryhaline fishes is better represented in Newfoundland freshwaters than any other family of fishes since no less

The lower part of the estuary of a small stream at Port au Port Bay (Station 9).

than 4 species occur. Two species, *Gasterosteus aculeatus* and *Pungitius pungitius,* are found in salt, brackish and freshwaters and appear to be more or less well distributed in the freshwaters of the island. The remaining two species, *Gasterosteus wheatlandi* and *Apeltes quadracus,* although occurring through salt, brackish and freshwaters, seem not to occur far inland, and in freshwaters are restricted to the lower 100 yards of streams.

Only on one occasion were all four species of sticklebacks collected at one station. The relative numbers of the four species taken in a 60 foot nylon seine in the fresh and brackish waters of a stream and its estuary at Station 9, Piccadilly Bay, Port au Port Bay, are shown in table 18.

Table 18. Comparative numbers of four species gasterosteids taken by seine in stream and its estuary in western Newfoundland

Species	Number of Specimens
Gasterosteus wheatlandi	604
Apeltes quadracus	43
Gasterosteus aculeatus	20
Pungitius pungitius	1

KEY TO STICKLEBACKS *(Gasterosteidae)*

1 Dorsal spines usually 9 (7 to 12), short and inclined alternately to left or right, gill membrane entirely free from isthmus, a median ventral plate present, no bony plates on sides.

Ninespine stickleback—*Pungitius pungitius*

Dorsal spines 3 to 6, gill membrane united to isthmus, usually bony plates along side and between pelvics (except in *Apeltes quadracus*) 2

2 Dorsal spines 4 or 5 (rarely 6), last spine attached to soft dorsal, spines inclined alternately to left and right side, a bony stay directed posteriorly from base of each pelvic fin, no median ventral plate.

Fourspine stickleback—*Apeltes quadracus*

Dorsal spines 3 (rarely 4), last spine not attached to soft dorsal, all spines in line, a strong median ventral plate extending posteriorly from pelvic base 3

3 Dorsal spines 3 (rarely 4), last spine short, pelvic fin of one spine and one soft ray, spine without two pointed cusps at base. Caudal peduncle with a keel. Body without round black spots. Colour in life green, blue or silvery.

Threespine stickleback—*Gasterosteus aculeatus*

Dorsal spines 3 (rarely 2), pelvic fin of one spine and two soft rays, spine with two well-developed pointed cusps at base. Caudal peduncle keelless. Many round black spots along sides. Colour in life lemon-yellow.

Twospine stickleback—*Gasterosteus wheatlandi*

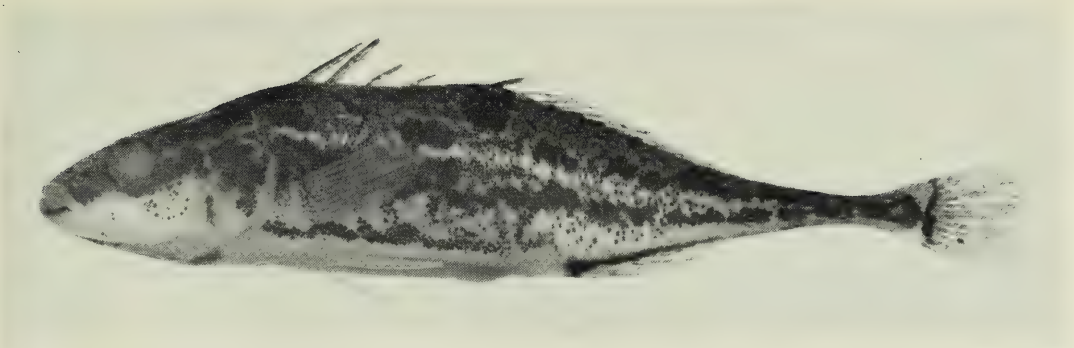


FIG. 15 Fourspine stickleback showing general shape, colour pattern and graduated dorsal spines (ROM 20989; 48 mm. total length).

Fourspine stickleback *Apeltes quadracus* (Mitchill) 1815

Stations: 9, 31.

Throughout its range in eastern North America the fourspine stickleback is a rather typical euryhaline species commonly found in estuarial environments. The most notable exception to this kind of habitat occurs in Nova Scotia where the fourspine stickleback is well established in a number of freshwater lakes and streams, far removed from the sea.

In Newfoundland, however, this stickleback follows its more typical behaviour pattern and remains in brackish water. During the current study the species was not caught in any freshwater location.

There has been only one previous record of the occurrence of this species in Newfoundland waters, that of Cox (1923a). Cox (*ibid*) reported on the regional variation of fourspine sticklebacks, with particular reference to the number of dorsal spines. In a tabular treatment of his data, Cox listed "Newfoundland . . . 3 0 0" referring to 3 specimens, none of which had 4 free dorsal spines. He gave no data for these other than the above notation and we can only speculate about the source of the specimens. Actually there is a very good possibility that these specimens were collected by Fritz Johansen in 1922 in the Port au Port Bay region of western Newfoundland. Johansen caught a number of fishes, including many sticklebacks in this region. In fact the next article in the Canadian Field Naturalist, following Cox's paper on regional variation, is a paper describing a new stickleback from Newfoundland, caught by Dr. Johansen, in Westbay, Port au Port Bay, September 2, 1922. It is surprising that Johansen did not mention the fourspine stickleback when he published the results of his Newfoundland collecting in 1926 (Johansen, 1926). It was from this same region, Port au Port Bay, that 43 specimens were collected during the 1960 field trip.

Thus, although Cox first recorded *Apeltes quadracus* from Newfoundland, the record has been entirely ignored and subsequent writers have referred to its range in a fashion similar to that of Bigelow and Shroeder (1953) who state " . . . from the southern side of the Gulf of St. Lawrence and Nova Scotia to Virginia." *Apeltes quadracus* is, however, well established in Newfoundland. Of the two collections reported here, one of them, Station 9, is on the Gulf of St. Lawrence or westward side of Newfoundland. (A specimen was also examined from the collections of the National Museum, Ottawa, collected on 15 July 1954 from the head of West Bay, Port au Port region, NMC 58-286.) But the second collection was taken at Station 31, from the estuary of the Come-by-Chance River at the head of Placentia Bay in the southeastern portion of Newfoundland and well outside the Gulf of St. Lawrence. Although these are the only collections known to exist there is no reason to doubt that the species is established in suitable localities along Newfoundland's south coast where no serious shore collections appear to have been made.

In his preliminary study of the variation in the number of dorsal spines in *Apeltes quadracus* Cox (1923a) remarked upon the number of 5 spined fish as opposed to 4 spined and associated the higher number of dorsal spines with decreased salinity. The meristic variability of this species has been critically studied by Krueger (1961). Krueger was unable to expand on Cox's findings regarding the correlation between number of dorsal spines and salinity because of the absence of accurate salinity data. Unfortunately precise salinity data are lacking also in the present study, but salinities at the collection sites on October 10, 1962 were 19.6 ppm at the lower station and 5.9 ppm at the upper station (*see* Appendix, Station 9, p. 111). Salinities were higher at Station 31. Some meristic data for the two collections are presented in Table 19.

Note that at Station 31, where the salinity is believed to be the highest, only 15% (8 specimens) of the sample had 5 dorsal spines and the remaining 85% (45 specimens) were 4 spined while at Station 9, with a lower salinity, 32% (14 specimens) had 5 spines, 63% (27 specimens) had 4 spines and 5% (2 specimens) had 3 spines or in other words the sample from the locality believed to have the lowest salinity had twice the percentage (32% compared to 15%) of 5 spined individuals. These data are in general in accord with the conclusions of Cox (1923a) and Krueger (1961) that the number of dorsal spines is correlated, inversely, with salinity.

The counts of rays for dorsal and anal fins are within the ranges determined by Krueger who examined available material from throughout the known range. Krueger's data showed a range of dorsal fin rays of 9-14 and of anal fin rays 7-11.

Table 19. Variation in spines and rays of dorsal and anal fins of "Apeltes quadracus"

	Dorsal Spines			N
	3	4	5	
ROM 20989 (Piccadilly)	2	27	14	43
Percentage	5%	63%	32%	
ROM 21030 (Come-by-Chance)		45	8	53
Percentage		85%	15%	

	Dorsal Fin Rays				N
	10	11	12	13	
ROM 20989	1	5	13	1	20

	Anal Fin Rays				N
	8	9	10		
ROM 20989	6	11	3		20

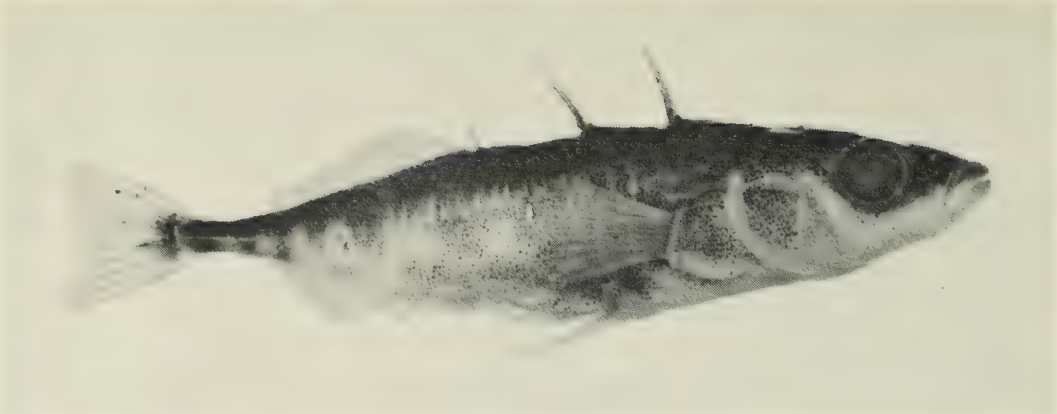


FIG. 16 Threespine stickleback showing general shape, dorsal spine arrangement and body markings (ROM 21031; 59 mm. total length).

Threespine stickleback *Gasterosteus aculeatus* Linnaeus 1758

Stations: 1, 2, 3, 4, 7, 8, 9, 13, 16, 17, 18, 19, 21, 23, 25, 26, 27, 29, 31, 32.

Collection: 4.

Other Common Names: Spantickle, banstickle, pinfish.

The threespine stickleback is the most common stickleback and the second most common species to be found in Newfoundland waters, occurring in 20 out of 33 collecting stations (the brook trout occurred at 22 stations). It has invaded almost every conceivable body of water on the island and is more tolerant of varied conditions than any other gasterosteid since it occurs in marine, brackish and freshwaters. Whereas *Apeltes quadracus* and *G. wheatlandi* tend to remain in waters of high salinity, and *Pungitius pungitius* in freshwaters, the threespine appears to successfully inhabit all shallow water habitats. It was the predominant gasterosteid in all collections except Station 9, where *G. wheatlandi* was overwhelmingly predominant.

The range of the threespine stickleback extends northward on the Canadian mainland to Hudson Strait thence across the arctic islands. Its occurrence and wide distribution in Newfoundland is thus in no way surprising.

Newfoundland specimens appear not to be unusual nor to deviate conspicuously from neighbouring populations. There is a need, however, for morphometric studies for the Atlantic region before any significant comparisons can be made. Some data on fin ray counts are presented in table 22 in comparison with *G. wheatlandi.*

Collections made throughout July contain gravid females and hence indicate that spawning occurs during this month. Many males brilliantly coloured with iridescent blues and greens were collected also during July although no nests were located nor any direct observations of spawning activities noted.

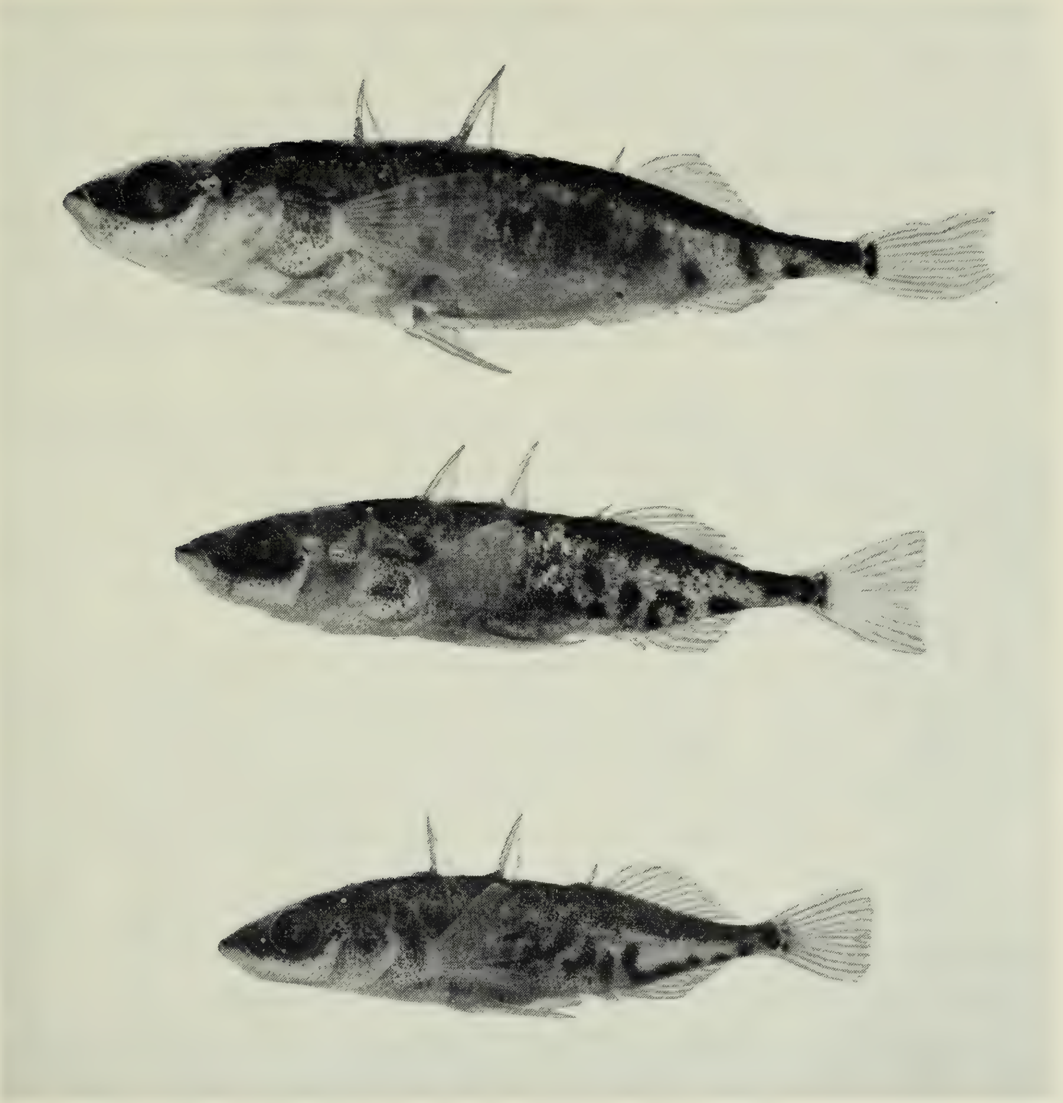


FIG. 17 Three different sizes of twospine sticklebacks showing general features and variation in colour pattern (ROM 20998; 49 mm: ROM 20998; 39 mm: ROM 21031; 34 mm. total length).

Twospine stickleback *Gasterosteus wheatlandi* Putnam 1867

Stations: 9, 31.

One of the most interesting species, ichthyologically, occurring in Newfoundland waters, is the twospine stickleback, *Gasterosteus wheatlandi* Putnam. Taxonomically, the species has had a checkered career being alternately accepted and rejected since first appearing in the literature in 1829. Hubbs (1929) noted that as far as he could determine, *G. wheatlandi* was first described by Cuvier and Valenciennes from Newfoundland under the name *"Gasterosteus biaculeatus,* Penn., Sh. at Mitch." Hubbs presented a comprehensive review of the taxonomy of the species and recommended as follows: "It should be known as *Gasterosteus wheatlandi* Putnam, or, I think preferably, as *Gladiunculus wheatlandi* (Putnam)." Hubbs concluded that the names *biaculeatus* and *bispinosus* should be referred to the synonymy of *Gasterosteus aculeatus.*

Mention must also be made of the species described by Philip Cox (1923b) as *Gasterosteus bispinosus Johanseni.* Although Cox had only one specimen available to him, his description leaves no doubt that *G. bispinosus Johanseni* Cox must join the long list of synonyms of *G. wheatlandi.*

The species occurs along the Atlantic coast from Newfoundland south to Massachusetts. McAllister (1960) has recorded it from a number of localities in Quebec, one of which, Riviere Gethsemanie, is said to be approximately 100 miles north of the Port au Port Bay collections. The largest specimen collected by us in Newfoundland in 1960 measured 50 mm. total length.

The species has been so frequently confused with *Gasterosteus aculeatus* that little is really known of its biology. Bigelow and Schroeder (1953), a reliable source book for information on American Atlantic fishes, states (p. 311) "Habits.—Its mode of life is the same as that of the three-spined species so far as known, and sticklebacks of this type have been described as building nests with bits of straw on sandy bottom in New York waters,[70] but the two species or races have been confused so often that nothing more definite can be said of its habits." Footnote 70 refers to Bean (1903) Fishes of New York. Bean was writing about a species he called *Gasterosteus bispinosus* Walbaum, which in his synopsis had a fully keeled caudal peduncle, among other characters. The reference to spawning, notes that the "male is red below and bluish and greenish above. . ." a description that leaves little doubt but that the species involved was *G. aculeatus.* Bean in fact included only this one species of *Gasterosteus* in his account of New York fishes and apparently was not familiar with *G. wheatlandi* despite the fact that he used the name *G. bispinosus.*

Although we can make no comments regarding actual spawning, a large number of gravid females and brilliantly coloured males were collected at Station 9, in brackish water. The males were conspicuously lemon-yellow in colour with distinct black markings (see Figure 17).

Standard length, egg number and average egg size are set out in table 20. The number of eggs varied from 140 to 276 and egg size varied from 1.2 mm. to 1.5 mm. in diameter. Very wide fluctuations will be noted in egg number and to some extent in egg size also. It may well be that some of the females were already spawning at the time of capture while others with high egg counts had not commenced to spawn. Although some eggs may have been lost during capture this seems unlikely since no extruded eggs were noticed at any time when handling the specimens. In the absence of comparative figures for the species elsewhere in its range we can only conclude that the variation in egg number is normal for a sample taken during the spawning period.

Table 20. Standard length, number of eggs and average egg size for 20 specimens of ripe female "G. wheatlandi"

Specimen Number	Standard Length mm.	Number of Eggs	Average Egg Size mm.
1	32	171	1.2
2	34	149	1.3
3	34	181	1.3
4	35	187	1.3
5	36	198	1.3
6	37	140	1.4
7	37	172	1.5
8	37	213	1.4
9	38	155	1.4
10	38	161	1.3
11	38	202	1.3
12	38	205	1.4
13	39	145	1.4
14	40	199	1.2
15	40	150	1.5
16	40	244	1.3
17	41	161	1.4
18	41	276	1.3
19	42	147	1.4
20	42	272	1.3
Mean and value	37.9	186.4	1.3

A comparison of dorsal and anal rays of *aculeatus* and *wheatlandi* (*see* table 21) shows some overlap in both characters. However, 66 per cent of the *wheatlandi* had 9 dorsal rays whereas 95 per cent of the *aculeatus* had 11 or 12. The degree of overlap is great for anal ray counts but again *wheatlandi* tends to have a lower number of rays than *aculeatus*.

By far the most useful character for separation of the two species are lateral cusps on both the inner and outer bases of the pelvic spine, which can be readily seen even with the naked eye. There is no cusp on the inner base of *aculeatus*.

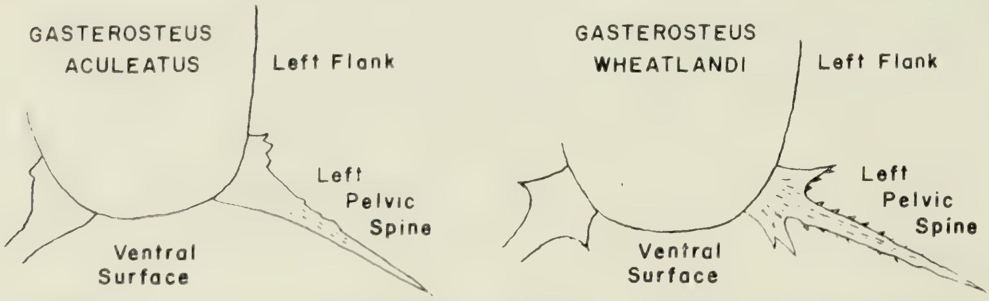
A summary of the more useful characters for separating these two species of *Gasterosteus* in Newfoundland is given in table 22.

Table 21. Dorsal and anal fin ray counts of "G. aculeatus" and "G. wheatlandi"

	Dorsal Rays							
	7	8	9	10	11	12	N	Mean
G. wheatlandi	1	0	20	9			30	9.2
G. aculeatus				1	9	8	18	11.4
	Anal Rays							
	6	7	8	9	10		N	Mean
G. wheatlandi	7	18	5				30	6.9
G. aculeatus			9	7	2		18	8.6

Table 22. A summary of some of the characters of use in differentiating Newfoundland "Gasterosteus"

Character	*Gasterosteus*	
	aculeatus	*wheatlandi*
Dorsal rays	usually 11 or 12	usually 9 or 10
Anal rays	usually 8 or 9	usually 7
Pelvic rays	one	two
Caudal peduncle	with strong lateral keels	keelless
Pelvic spine	with cusp on outer surface of base only	with cusps (pointed spines) on inner and outer surface of base.
Size	total length to 70 mm.	total length to 50 mm.
Color	blue, green or silvery, often with vertical bars	lemon-yellow with distinct black spots and blotches
Habitat	marine brackish and fresh-water	marine and brackish



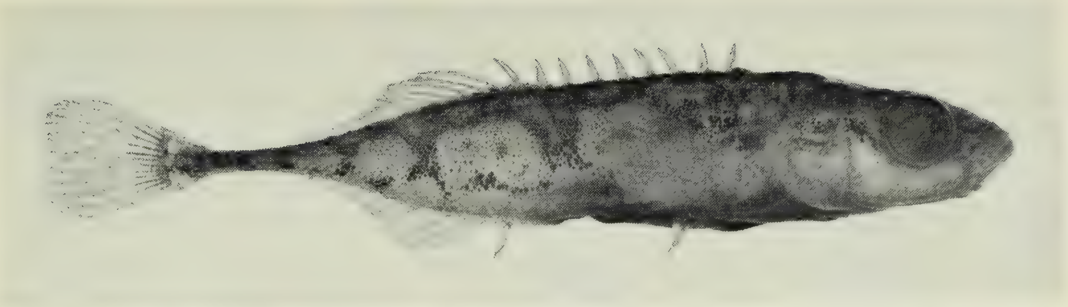


FIG. 18 Ninespine stickleback showing dorsal spine arrangement and general body shape (ROM 20972; 44 mm. total length).

Ninespine stickleback *Pungitius pungitius* (Linnaeus) 1758

Stations: 4, 9, 21.

Collections: 20.

The ninespine stickleback is a wide ranging species occurring in every province or territory of Canada except British Columbia. It is, therefore, not surprising to find it among those species that have become established in Newfoundland's freshwaters.

It is significant that this species is rare or absent from the estuarine collections. Note that at Station 9 it was recorded on the basis of a single specimen, the remainder of the observations being all from freshwater. The ninespine stickleback is thus primarily a freshwater species in Newfoundland. Although the species has been recorded from only four localities there seems no reason to doubt that it is more widely distributed. Further collecting will surely reveal its presence in other watersheds in the province but it is a small, secretive fish unlikely to be caught by casual collecting.

Johansen (1926) reported the occurrence of the species in insular Newfoundland (as *Pygostius pungitius*) on the basis of a single specimen caught in the Port au Port Bay region of western Newfoundland. This record, in the main, appears to have been overlooked. However, in 1951, a single specimen was taken in the Northwest Gander River by Fisheries Research Board personnel during salmon investigations. This record was published by Scott (1954) after a search revealed that no Newfoundland specimens of the ninespine stickleback were retained in any of the major research collections in North America. Scott (*ibid*) noted ". . . it is presumed that the species is uncommon in Newfoundland waters." This statement requires some modification since although the species was recorded only three times during the 1960 field trip, it was obviously well established in two of these (Station 4- 80 specimens; Station 21- 53 specimens). In August 1962 Dr. A. Fleming, Fisheries Research Board of Canada, reported collecting the species in Dildo Pond, Dildo, Trinity Bay, Avalon Peninsula.

The only person who has referred to this species as common in Newfoundland is Reeks (1871). Reeks' report is of rather general interest and his whole section on *Pungitius pungitius* is worth repeating.

"Ten-spined stickleback (*G. pungitius*). Common in fresh as well as brackish water. I obtained some from small brackish streams near St. Paul's Bay. One which I preserved in alcohol, with some of the preceding species, and forwarded to the British Museum, appears to have been lost or overlooked, as it was not observed by Dr. Gunther, who obligingly examined the contents of the bottle for me. If I remember rightly I never found a specimen with more than *nine* spines, but I certainly captured more than one on which I could not detect more than *eight* spines, and I fully believe that the specimen referred to above had only the latter number: I am grieved that it is lost, as it may have proved a distinct species. With regard to the 'nuptial dress' of the Newfoundland sticklebacks, I am sorry to say that I paid insufficient attention to the subject, and collected my specimens, I think, in October."

The variation in number of dorsal spines is given in Table 23 for a sample from Station 4. Notice that 34% of the sample had eight spines, a feature that Reeks took special note of. Note also that the European name, ten-spined stickleback, was employed by Reeks instead of nine-spine stickleback, the name regularly used in North America.

The number and arrangement of the dorsal spines are the most obvious means of ready identification. The spines commonly total 9 but may range from 7 to 12 (Bigelow and Schroeder, 1953).

Table 23. Range of variation in dorsal spines of "Pungitius pungitius"

	Dorsal Spines					
	7	8	9	10	Mean	N
North Harbour River Station 4 ROM 20972	1	22	37	5	8.7	65
Percentage	1	34	57	8		100%

American sand lance *Ammodytes americanus* DeKay 1842

Although typically a marine species the sand lance was taken in rather large numbers along with eight other species (appendix table 1) by seine haul in the lower section of a small brook in the Piccadilly Bay region of Port au Port Bay, southwestern Newfoundland. A total of 137 specimens were caught ranging in total length from 107 to 155 mm. (standard length 96-142 mm.).

The conditions obtaining at Station 9 were definitely brackish as described in greater detail in appendix table 1. Previous reports of *Ammodytes americanus* occurring in similar locations are scarce although the species does frequent inshore waters including the intertidal zone, particularly over sandy bottoms.

No explanation for the occurrence of sand lance in this brackish water is offered. The specimens in the sample were not in ripe condition, in fact sex was difficult to determine. All specimens in the sample were infected with black spot parasites (possibly trematode metacercaria). The larger specimens were much more heavily infected than the smaller ones.

Anal and dorsal fin ray counts for a portion of the sample are given in table 24. The fin ray counts show a wider range of variation (dorsal count 54-60, anal count 24-33) than suggested by Bigelow and Schroeder (1953) (dorsal count 59-64, anal count 28-32) and Backus (1957) (dorsal count 57-60, anal count 28-31) but are within the range of variation for *A. americanus* rather than that for *A. dubius* Reinhardt 1838. Bigelow and Schroeder report fin ray counts of 65-67 for dorsals and 33-36 for anals for *A. dubius*.

Table 24. Dorsal and anal fin ray counts in relation to standard length of "Ammodytes americanus"

Standard Length Groups mm.	Dorsal Fin Rays							Anal Fin Rays									
	54	55	56	57	58	59	60	24	25	26	27	28	29	30	31	32	33
100–109		1	1	1		1					2			2			
110–119	1	2									2				1		
120–129	1	2		1			1	1					2	1		1	
130–139	1		2	2			1					3	1	1			1
140–149		1	1										2				
Totals	3	6	4	4	0	1	2	1	0	0	4	3	5	4	1	1	1

An upstream spawning area of Indian River draining the southern part of the Baie Verte Peninsula.

Windowpane *Scophthalmus aquosus* (Mitchill) 1815[1]

A single specimen of the windowpane or fluke was taken by seining in the brackish estuary of the small stream in the Port au Port Bay region (Station 9). This region, Port au Port Bay, is apparently the northeasterly limit of range for the species. The Annual Report for the Newfoundland Fishery Research Commission for 1932 (published 1933) notes, (p. 127) that three specimens were taken at Station 185; this station is listed as 48° 40′ N, 53° 33′ 30″ W (Port au Port Bay). These early specimens were taken in water 18 metres deep and having a salinity of 30.79 parts per thousand.

Other than these specimens from Port au Port Bay, taken on two separate occasions, 1932 and 1960, there seem to be no records of occurrence of the windowpane in the inshore waters of Newfoundland, either saline or brackish (*see* salinity value in appendix comments on Port au Port site).

Data for the present brackish water specimen (ROM cat. no. 21942) are as follows: sex—immature, standard length 139 mm. (total length 192 mm.); dorsal fin ray count 69, anal fin ray count 53. These counts approach the upper limit of range recorded for the species given by Moore (1947) as, dorsal ray count range 63-73, and anal ray count range 48-54. Bigelow and Schroeder (1953) present the ray count for these two fins as, dorsal 63-69 and anal 46-52. It is evident, therefore, that the fin ray counts of this single specimen do approach the extreme limit of range for the species.

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[1] Also referred to as *Lophopsetta maculata* (Mitchill) and *Lophopsetta aquosa* (Mitchill).

Winter flounder *Pseudopleuronectes americanus* (Walbaum) 1792

Stations: 9.

Collections: 7.

The winter flounder is a marine species commonly found in the shallow waters of the Canadian Atlantic coast. Backus (1957) records Windy Tickle (55° 45′ N) as the northern limit of range along the Labrador coast.

The presence of small, young winter flounder in the shallow waters of bays and estuaries of the Gulf of St. Lawrence area is well known and hence there is nothing especially significant about the two records noted above. There are, however, few published records of the occurrence of this flatfish in brackish waters, despite the fact that the habit of the young fish frequenting estuarial waters is well known. The two samples, one from Station 9 (19 specimens, total lengths 49-159 mm.) and the other, Collection 7 (5 specimens, total lengths 180-247 mm.), were composed of young fish.

Perlmutter (1947) has drawn attention to the fact that the young winter flounder frequent inshore areas, including brackish estuaries, moving off into deeper water as they grow older. As noted in the Discussion, the invasion of brackish water by the young is not restricted to the winter flounder but is characteristic of many marine species. McCracken (pers. comm.) notes that although winter flounders are commonly found in estuaries this usually occurs where the salinity is greater than 20 parts per thousand and that experimental exposure to freshwater resulted in death in 24-48 hours (*see* salinity value in appendix comments on Port au Port site).

The figures for fin ray counts in table 25 compare favourably with those given by Backus (1957) for Labrador specimens (dorsal fin range 61-67, anal fin range 44-50) but are much lower than ranges presented by Bigelow and Schroeder (1953) (dorsal fin range 60-76, anal fin range 44-58).

Table 25. Dorsal and anal fin ray counts of "Pseudopleuronectes americanus" from Newfoundland

Dorsal fin rays	59	60	61	62	63	64	65	66	N
	1	5	2	9	1	4	0	2	24
Anal fin rays	44	45	46	47	48	49			N
	2	1	7	6	5	3			24

DISCUSSION

In this paper we are using the term Newfoundland to mean the island of Newfoundland rather than the Province, which includes the Labrador or mainland portion whose fish fauna is typically mainland Canadian.

The fish fauna of the island is, however, governed by the salinity tolerance of those fish species available to repopulate the island since glaciation. The native species and their zoogeographic bases are presented in tabular form below:

HOLOARCTIC	*Salvelinus alpinus*
	Gasterosteus aculeatus
	Pungitius pungitius
ATLANTIC	*Petromyzon marinus*
	Salmo salar
WESTERN NORTH ATLANTIC	*Acipenser oxyrhynchus*
	Alosa pseudoharengus
	Alosa sapidissima
	Osmerus mordax
	Anguilla rostrata
	Fundulus heteroclitus
	Microgadus tomcod
	Apeltes quadracus
	Gasterosteus wheatlandi
	Ammodytes americanus
	Scophthalmus aquosus
	Pseudopleuronectes americanus
EASTERN NORTH AMERICA	*Salvelinus fontinalis*
	Fundulus diaphanus

Zoogeographic Bases for Fishes found in Newfoundland Freshwaters

All 23 species recorded are to a greater or lesser extent euryhaline. Primary freshwater species as defined by Myers (1937) or Darlington (1957) do not occur on Newfoundland despite its proximity to the mainland. Only those species capable of traversing a salt water barrier have successfully invaded the freshwaters of the island. The narrowest part of the marine barrier, the Strait of Belle Isle, is adjacent to an area of North America having a very depauperate freshwater fauna.

A total of 23 fish species in 13 families have been shown to occur:

- *Petromyzonidae*
    - *Petromyzon marinus*
- *Acipenseridae*
    - *Acipenser oxyrhynchus*
- *Clupeidae*
    - *Alosa pseudoharengus*
    - *Alosa sapidissima*
- *Coregonidae*
    - *Coregonus clupeaformis*
- *Salmonidae*
    - *Oncorhynchus gorbuscha*
    - *Salmo gairdneri*
    - *Salmo salar*
    - *Salmo trutta*
    - *Salvelinus alpinus*
    - *Salvelinus fontinalis*
- *Osmeridae*
    - *Osmerus mordax*
- *Anguillidae*
    - *Anguilla rostrata*
- *Cyprinodontidae*
    - *Fundulus diaphanus*
    - *Fundulus heteroclitus*
- *Gadidae*
    - *Microgadus tomcod*
- *Gasterosteidae*
    - *Apeltes quadracus*
    - *Gasterosteus aculeatus*
    - *Gasterosteus wheatlandi*
    - *Pungitius pungitius*
- *Ammodytidae*
    - *Ammodytes americanus*
- *Bothidae*
    - *Scophthalmus aquosus*
- *Pleuronectidae*
    - *Pseudopleuronectes americanus*

Of the 23 species listed above, 20 belong to categories which are placed low in the phylogenetic scale of fishes. Approximately half belong to a single order of generalized soft-rayed bony fishes (Isospondyli). However, the last three species listed are specialized spiny-rayed bony fishes that are not usually included in lists of fishes inhabiting fresh or brackish waters. In fact, Gunter (1956) has summarized the available data on the occurrence of euryhaline fishes for the Atlantic coastal region and has listed those marine species known to frequent brackish waters. These three, *A. americanus, S. aquosus, P. americanus,* are not included. While some flatfishes, including the young of the winter flounder, are known to penetrate estuarine waters, this would seem to be the first report for *Ammodytes americanus.* Gunter (*ibid*) has drawn attention to this penetration of brackish waters by the young of marine species. The *A. americanus* taken at Port au Port were of adult size although sex could not be determined.

The authors are very much aware that many vital areas of Newfoundland have been ignored in this report which is based on limited field work, a thorough literature search and study of available reference collections. Further field work in the northwestern peninsula, Burin Peninsula and the area westward along the south coast to Port aux Basques will doubtless fulfill Halkett's 1913 prophesy and extend our knowledge of Newfoundland's ichthyofauna.

Early construction stages of an artificial spawning area for Atlantic salmon on Indian River. This is associated with an hydroelectric water diversion.

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APPENDIX

APP. TABLE 1. MATERIAL COLLECTED ON SURVEY

Station No.	Location	Watershed	Date 1960	Species Taken (M) = Migratory (N) = Non-Migratory	N.	Range T.L.* mm.	ROM Cat. No.
1	Ferryland—brook crossing Hwy. No. 5, 1 mi. N Trepassey.	Direct Atlantic	7 July	*Salvelinus fontinalis* *Gasterosteus aculeatus*	22 48	35–55 45–75	20963 20964
2	St. Mary's—brook draining pond crossing No. 6 Hwy., 6 mi. W St. Catherines on St. Catherines—Colinet Road.	Direct Atlantic	8 July	*Salvelinus fontinalis* *Gasterosteus aculeatus*	17 15	40–125 20–55	20965 20966
3	St. Mary's—stream trib. to North Harbour R., at Dept. Fish. cabin.	North Harbour River St. Mary's Bay	8 July	*Salvelinus fontinalis* *Gasterosteus aculeatus*	2 50	28–36 15–55	20967 20968
4	St. Mary's—pond margin and stream (connecting 2 ponds) crossing No. 6 Hwy., at North Harbour Rd.	North Harbour River St. Mary's Bay	8 July	*Salvelinus fontinalis* *Anguilla rostrata* *Gasterosteus aculeatus* *Pungitius pungitius*	16 6 90 79	35–175 200–510 20–70 17–50	20969 20970 20971 20972
5	Placentia East—small brook crossing No. 6 Hwy., ½ mi. E of junction No. 6 and No. 8 Hwys.	Southeast River Placentia Bay	9 July	*Salmo salar* *Salvelinus fontinalis*	3 34	40–110 33–115	20973 20974
6	St. Mary's—North Harbour R., first pool below Dept. Fish. cabin.	North Harbour River St. Mary's Bay	9 July	*Salmo salar* (*M*) *Salmo trutta* (*M*) *Salvelinus fontinalis* (*N*)	1 1 2	120 310 190 and 220	20975 20976 20977
7	Trinity South—small roadside pool fed by trib. to Broad Lake.	Trinity Bay	10 July	*Gasterosteus aculeatus*	41	20–70	20978
8	Bonavista North—Middle Brook, 150 yds. downstream from Trans. Can. Hwy.	Freshwater Bay Bonavista Bay	11 July	*Salmo salar* *Salvelinus fontinalis* *Gasterosteus aculeatus*	10 4 2	35–115 45–120 45–46	20979 20980 20981

*Size as given here is that at time of cataloguing, August 1960. Sizes given in text are from measurements taken one year later after shrinkage.

9	Port au Port—brook and estuary of Piccadilly Bay.	Port au Port Bay Gulf of St. Lawrence	14 July	*Salvelinus fontinalis* (*M*)	37	90–250	20982
				Osmerus mordax	45	125–220	20983
				Scophthalmus aquosus	1	190	21942
				Pseudopleuronectes americanus	19	50–159	20984
				Ammodytes americanus	137	115–155	20985
				**Fundulus heteroclitus*	194	39–67	20986
				**Gasterosteus aculeatus*	20	41–61	20987
				Gasterosteus wheatlandi	604	30–41	20988
				**Apeltes quadracus*	43	29–53	20989
				Pungitius pungitius	1	58	20990
10	St. George's—Seal Cove Brook, N and S of Hwy. No. 47, 12 mi. E Stephenville.	St. George's Bay	14 July	*Fundulus heteroclitus*	152	38–74	20991
				F. diaphanus	89	39–63	21979
11a	St. George's—Grand Lake, E shore, 10 min. run from U.S.A.F. camp.	Humber River Bay of Islands	15–16 July	*Salvelinus fontinalis* (*N*)	1	220	20992
b	St. George's—Grand Lake, S W shore, 10 min. run from U.S.A.F. camp.	Humber River Bay of Islands	16–17 July	*Salvelinus alpinus* (*N*)	1	125	20993
				Salvelinus fontinalis (*N*)	4	240–490	20992
12	Humber—brook entering pond at Trans. Can. Hwy., 20 mi. S Cornerbrook.	St. George's Bay	16 July	*Salvelinus fontinalis*	58	35–90	20994
13	St. George's—trib. stream to Grand L., W shore, 10 min. run N of U.S.A.F. camp.	Humber River Bay of Islands	16–17–18 July	*Salvelinus fontinalis*	35	35–160	20995
				Gasterosteus aculeatus	3	40–50	20996
14a	Humber — St. George's — Lake St. George, 20 mi. S Cornerbrook, W shore	Harry's River St. George's Bay	17–18 July	*Salvelinus alpinus* (*N*)	1	338	20998
b	Humber — St. George's — Lake St. George, W shore, near C.N.R. tracks.	Harry's River St. George's Bay	18–19 July	*Salmo salar* (*M*)	1	530	20997
				Salvelinus alpinus (*N*)	4	190–360	20998
				Salvelinus fontinalis (*N*)	7	205–290	20999
				Anguilla rostrata (seen but not captured)			

*Taken in definite freshwater.

APP. TABLE 1. MATERIAL COLLECTED ON SURVEY—Conc.

Station No.	Location	Watershed	Date 1960	Species Taken (M) = Migratory (N) = Non-Migratory	No. of Species	Range T.L. mm.	ROM Cat. No.
15	Grand Falls—brook crossing Trans. Can. Hwy., 15 mi. N Badger.	Notre Dame Bay	20 July	*Salvelinus fontinalis*	10	45–115	21000
16	Grand Falls—outlet of Rushy Pond, at Trans. Can. Hwy.	Exploits River Bay of Exploits	20 July	*Gasterosteus aculeatus*	28	18–58	21001
17	Gander—Little Rattling Br., at Dept. Fish. cabin near Norris Arm.	Bay of Exploits	20 July	*Gasterosteus aculeatus*	225	15–65	21002
18	Gander—trib. to O'Brien L., at Trans. Can. Hwy.	Gander River Gander Bay	20 July	*Salvelinus fontinalis* *Gasterosteus aculeatus*	3 57	35–170 20–60	21003 21004
19	Gander—pond crossed by Trans. Can. Hwy., 1 mi. E L. O'Brien.	Gander River Gander Bay	20 July	*Gasterosteus aculeatus*	55	15–58	21005
20	Gander—Gander L., 300 yds. E pumping station, off N shore.	Gander River Gander Bay	20–21 July	*Salvelinus alpinus* (*N*) *Salvelinus fontinalis* (*N*) *Osmerus mordax* (*N*)	1 2 2	190 200–220 190–240	21006 21007 21008
21	Bonavista North—Gambo L. narrows, small weedy bay, 300 yds. downstream from Dept. Fish. cabin.	Freshwater Bay Bonavista Bay	23 July	*Gasterosteus aculeatus* *Pungitius pungitius*	78 52	12–60 12–40	21009 21010
22	Bonivista North—small pool near mouth of Oliver's Br., trib. Gambo L., 1 mi. below Dept. Fish. cabin.	Freshwater Bay Bonavista Bay	23 July	*Salvelinus fontinalis* (*N*) *Salvelinus fontinalis* (*M*)	28 9	155–250 173–200	21011 21012
23	Bonavista North—Parsons Br., (mouth), trib. Gambo L., ½ mi. below Dept. Fish. cabin.	Freshwater Bay Bonavista Bay	23 July	*Salmo salar* *Gasterosteus aculeatus*	21 10	35–110 20–50	21013 21014
24a	Bonavista North—Gambo L., Half way up lower Gambo L.	Freshwater Bay Bonavista Bay	23–24 July	*Salmo salar* (*M*) (*N*) *Salvelinus fontinalis* (*M*)	8 6	170–480 195–305	21015 21016
b	Bonavista North—Gambo L., Lower Gambo L., @ 1 mi. above outlet.	Freshwater Bay Bonavista Bay	24–25 July	*No fish*			

25	Fortune Bay and Hermitage—Lake St. John (John's Pond), outlet immediately below dam on A.N.D. Co. road.	Terra Nova River Bonavista Bay	25 July	*Salmo salar* (*N*)	22	80–170	21017
				Salvelinus fontinalis (*N*)	25	60–200	21018
				Anguilla rostrata	1	120	21019
				Gasterosteus aculeatus	62	40–65	21020
26	Fortune Bay and Hermitage—small backwater of Northwest R., trib. Lake St. John.	Terra Nova River Bonavista Bay	26 July	*Gasterosteus aculeatus* (*S. fontinalis* seen, not captured)	89	10–55	21021
27	Fortune Bay and Hermitage—Lake St. John, slough dam on A.N.D. Co. road, shallow below dam.	Terra Nova River Bonavista Bay	26 July	*Salmo salar* (*N*)	16	90–200	21022
				Salvelinus fontinalis (*N*)	9	65–190	21023
				Gasterosteus aculeatus	30	20–55	21024
28	Fortune Bay and Hermitage—Deer Pond, dam at outlet, on A.N.D. Co. road.	Terra Nova River Bonavista Bay	26 July	*Salmo salar* (*N*)	2	140–160	21025
				Salvelinus fontinalis (*N*)	10	150–190	21026
29	Fortune Bay and Hermitage—small roadside pond on A.N.D. Co. road, 100 yds. E Southwest R. bridge.	Terra Nova River Bonavista Bay	26 July	*Gasterosteus aculeatus*	303	8–70	21027
30	Fortune Bay and Hermitage—Lake St. John (John's pond), mouth of Ferrier's Br.	Terra Nova River Bonavista Bay	26–27 July	*Salmo salar* (*N*)	24	140–520	21028
				Salvelinus fontinalis (*N*)	10	180–400	21029
				Osmerus mordax (*N*) (from stomach of *S. salar*)			
31	Trinity South—tidepools of Come-By-Chance R., estuary at end of Come-By-Chance road.	Placentia Bay	28 July	*Apeltes quadracus*	53	20–55	21030
				Gasterosteus aculeatus	92	12–60	21031
				G. wheatlandi	1	34	21980
32	Trinity South—small stream crossing Trans. Can. Hwy., 1 mi. N Arnold's Cove.	Trinity Bay	28 July	*Salvelinus fontinalis*	60	32–130	21032
				Gasterosteus aculeatus	7	30–65	21033
33	St. John's North—Hogan's Pond, 7 mi. W St. John's.	Conception Bay	28–29 July	*Coregonus clupeaformis*	11	280–350	21034

APP. TABLE 2. COLLECTIONS OF NEWFOUNDLAND FRESHWATER FISHES IN ROM, EXCLUSIVE OF SURVEY

Collection No.	Location	Watershed	Date	Collector	Species Taken (M) = Migratory (N) = Non-Migratory	N	Size Range mm.	ROM Cat. No.
1	Bonavista North—Butt's Pond.	Freshwater Bay Bonavista Bay	21 Sept. to 23 Oct. 1958	O'Reilly and Mercer	*Salvelinus fontinalis* (*M*)	6	120–230	21035
					Salvelinus alpinus (*N*)	14	90–425	21036
					Osmerus mordax (*N*)	8	135–250	21037
2	Bonavista North—Gambo L., vicinity Triton Br.	Freshwater Bay Bonavista Bay	23 May 1957	T. Curran	*Salmo salar* (*M*) *or* (*N*)	1	120	21038
					Salvelinus alpinus (*N*)	7	130–270	21039
3	Trinity—Conception—Shalloway Pond, vicinity Fox Harbour.	Placentia Bay	30 June 1957	A. J. O'Keefe	*Salvelinus alpinus* (*N*)	1	200	21040
4	Ferryland—Gull Is., Witless Bay tidepools.	Atlantic	9 July	S. Peters	*Gasterosteus aculeatus*	8	40–70	21050
5	St. Mary's—picked up on beach E side Holyrood Pond.	St. Mary's Bay	7 July	W. B. Scott and E. J. Crossman	*Mallotus villosus*	6	160–180	21051
6	Placentia—Placentia roads, entrance to Placentia Harbour.	Placentia Bay	July 1958	Comm. Fish. via O'Keefe	*Acipenser oxyrhynchus*	1	660	21052
7	St. George's—Little Codroy R., F.R.B. salmon fence.	Searston Bay Cabot Strait	25–27 July 1960	A. Murray	*Anguilla rostrata*	7	90–630	21041
					Salvelinus fontinalis (*M*)	8	190–270	21042
					Salmo salar (*M*)	5	75–100	21043
					Osmerus mordax (*M*)	15	140–180	21044
					Alosa pseudoharengus	2	150–270	21045
					Pseudopleuronectes americanus	5	180–250	21046

8	St. George's—Little Codroy R., little island below salmon fence.	Searston Bay Cabot Strait	June 1960	Les Tuck	*Fundulus heteroclitus*	2	45–95	21048
9	St. George's—McIsaacs Is., Little Codroy River	Searston Bay Cabot Strait	26 July 1960	Les Tuck	*Fundulus heteroclitus*	5	30–55	21049
10	South Twin Lakes	Exploits R. Notre Dame Bay	28 Oct. 1949	A. Blackhurst A. A. Blair	*Salmo salar* (*N*)	6	252-315	15720—15726
					Salvelinus alpinus (*N*)	9	142–150	15727, 15886—15889
					Salvelinus fontinalis (*N*)			15724
11	Dildo Pond	Dildo Arm Trinity Bay	18 Nov. 1949	A. Blackhurst A. A. Blair	*Salmo salar*	2		15732 15733
					S. trutta	1		15731
12	Ocean Pond	Dildo Arm Trinity Bay	20 Nov. 1949	A. Blackhurst A. A. Blair	*Salmo salar* (*N*)	11		15734—15744
					Salvelinus fontinalis (*N*)	1		15748
13	Mobile Big Pond	Atlantic Ocean	26 Nov. 1949	A. Blackhurst A. A. Blair	*Salmo salar*	3		15745—15747
14	Moretons Harbour Pond, New World Island	Notre Dame Bay	30 Sept. 1948 26 Dec. 1949	F Spencer A. A. Blair	*Salvelinus alpinus* (*N*)	3		15719, 15895
15	Grand Lake	Humber R. Bay of Islands	various 1949	A. Blackhurst A. A. Blair	*Salvelinus alpinus* (*N*)	3		15728—15730
					S. fontinalis (*N*)	2		15752 15753
16	Gander River	Gander Bay Notre Dame Bay	7 Aug. 1951	G. B. Wiggins C. W. Andrews	*Salvelinus alpinus*	5		15890—15894

APP. TABLE 2. COLLECTIONS OF NEWFOUNDLAND FRESHWATER FISHES IN ROM, EXCLUSIVE OF SURVEY—Conc.

Collection No.	Location	Watershed	Date	Collector	Species Taken (M) = Migratory (N) = Non-Migratory	N	Size Range mm.	ROM Cat. No.
17	Gull Pond	Salmonier R. St. Mary's Bay	29 Nov. 1949	A. Blackhurst A. A. Blair	*Salvelinus fontinalis* *Osmerus mordax*	1 1		15754 15758
18	Oxley's Pond	Salmonier R. St. Mary's Bay	30 Nov. 1949	A. Blackhurst A. A. Blair	*Salvelinus fontinalis*	1		15755
19	Hawco's Pond	Salmonier R. St. Mary's Bay	1 Dec. 1949	A. Blackhurst A. A. Blair	*Salvelinus fontinalis*	1		15756
20	N. W. Gander River	Gander Bay Notre Dame Bay	7 Aug. 1951	G. B. Wiggins C. W. Andrews	*Pungitius pungitius*	1	65	16020
21	Landown's Pond	Harry's River St. George's Bay	May 1948	Warden Oliver	*Salvelinus alpinus* (*N*)	3	255–257	21807
22	Thomas Pond	Manuels River Conception Bay	21 July 1962	A. R. Murray	*Salmo trutta* (*N*)	1	198	21857
23	First Pond, Caplin Cove Brook	Notre Dame Bay	9 Sept. 1962	Pratt and Cowley	*Salvelinus alpinus* (*N*)	1	248	21897
24	Gander Lake	Gander R.	26 Oct. 1949	A. Blackhurst A. A. Blair	*Osmerus mordax*	2		15759 15760
25	St. George's—Frank White's Brook, trib. to Little Codroy River	Searston Bay Cabot Strait	25 July 1960	A. R. Murray	*Salmo salar*	5	120–140	21047
26	St. Mary's—North Harbour River	St. Mary's Bay	last week of Sept. 1962	Seabrook	*Salmo trutta*	1	666	21966

APP. TABLE 3. TABULAR ARRANGEMENT OF STATIONS AND COLLECTIONS TO INDICATE FREQUENCY OF OCCURRENCE

Species	Spec. No.	Stations																																	Total Occurrences at Stations	Collections																										Grand Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
Petromyzon marinus	1																																																													0
Acipenser oxyrhynchus	2																																								X																					1
Alosa pseudoharengus	3																																									X																				1
Alosa sapidissima†	4																																																													0†
*Coregonus clupeaformis**	5																																	X	1																											1
*Oncorhynchus gorbuscha**	6																																																													0
*Salmo gairdneri**	7																																																													0
Salmo salar	8					X	X		X						X									X	X	X		X	X		X				10		X					X			X	X	X	X												X		17
*Salmo trutta**	9						X																												1											X											X				X	4
Salvelinus alpinus	10											X			X						X														3	X	X	X							X				X	X	X					X		X				12
Salvelinus fontinalis	11	X	X	X	X	X	X		X	X		X	X	X	X	X			X		X		X		X	X		X	X		X		X		22	X						X			X		X			X		X	X	X								30
Osmerus mordax	12									X											X										X				3	X						X										X							X			7
Anguilla rostrata	13				X																					X									2							X																				3
Fundulus diaphanus	14										X																								1																											1
Fundulus heteroclitus	15									X	X																								2								X	X																		4
Microgadus tomcod†	16																																																													0†
Apeltes quadracus	17									X																						X			2																											2
Gasterosteus aculeatus	18	X	X	X	X			X	X	X				X			X	X	X	X		X		X		X	X	X		X		X	X		20				X																							21
Gasterosteus wheatlandi	19									X																						X			2																											2
Pungitius pungitius	20				X					X												X													3																				X							4
Hemitripterus americanus	21									X																									1																											1
Scophthalmus aquosus	22									X																									1																											1
Pseudopleuronectes americanus	23									X																									1							X																				2

*Introduced species.
†After this table was compiled specimens were received.

APP. TABLE 2. COLLECTIONS OF NEWFOUNDLAND FRESHWATER FISHES IN ROM,

ROM Cat. No.
15754 15758
15755
15756
16020
21807
21857
21897
15759 15760
21047
21966

EXTRACT FROM THE *ST. JOHNS EVENING HERALD*
FEBRUARY 23rd, 1892

THE GAME FISH PROTECTION SOCIETY
Its successful and useful efforts in restocking our ponds

Encouraging Figures

The figures which we append will show the extent of the labours of this very useful Association. Its members have expended a sum of over $1,800 in the importation, cultivation and protection of new varieties of game fishes in Newfoundland, and it is only very recently that their labours and expenditure have been to some extent appreciated. The introduction and growth of the noble Lochleven Trout, and the magnificent Rainbow Trout of California, have lately proved a great success. There can be no doubt that eight and nine pound Lochleven Trout may be reasonably looked for in the coming season in Quidi Vidi and other "open" ponds. The only "close" pond to which the members of the Society have a temporary exclusive right is Upper Long Pond. As yet no large fish have been taken in this preserved water, and it would appear that most of the larger trout had gone down towards, and to the sea.

The First Importation of Ova

The first importation of ova, for public purposes, took place in January of 1886. The Hatchery at Long Pond had then been erected and equipped by the Society and under the loving care and scientific oversight of our veteran sportsman, Mr. John Martin, 100,000 Lochleven ova were hatched out in 106 days with a loss of a very small percentage. Of the produce 20,000 were reserved for Upper Long Pond, and a portion of the residue distributed as follows:

Quidi Vidi	10,000
Cove Road Ponds	10,000
Monday's Pond	5,000
Topsail Road Ponds	15,000
Emerson's (Virginia)	1,000

In March of the same year, there were imported 200,000 White Fish ova and 500,000 Salmon Trout. The White Fish were hatched out in 21 days, and turned out into open water, as follows:

Murray's Pond	50,000
Hogan's Pond (Broad Cove R's)	100,000
South Side Hill Ponds	50,000

In 73 days the Salmon Trout were hatched out, and on the 24th May, 1886, were distributed as under:

Bay Bulls Ponds	100,000
Mr. March (for Old Perlican Ponds)	5,000
Salmonier Ponds	5,000
Late Rev. M. F. Morris (for Topsail and vicinity)	50,000
Topsail Road Ponds, (J. & W. Boyd)	100,000
Quidi Vidi	10,000
Long Pond	5,000

In 1888, in January, another 100,000 Lochleven Trout were imported, and hatched out on the 24th May. Of these there were turned into:

The Petty Harbour Ponds	10,000
Lower Island Ponds	10,000
Quidi Vidi	10,000
Long Pond	40,000

In 1889, in January, another 100,000 Lochleven's were imported and turned out on May 24th. The distribution was as follows:

South Dildo Pond, Trinity Bay	10,000
Topsail Pond	2,000
Petty Harbour Ponds	3,000

Of Hybrids (salmon and trout) 40,000 were put into the Quidi Vidi River.

In April, of 1890, 100,000 eggs of the celebrated California Rainbow trout were imported. The young fry were again hatched out on May 24th, which seems to be a date of auspicious recurrence. On the 16th June they were turned free and partly distributed as follows:

Murray's Pond, Cove Road	1,000
Windsor Lake	2,000
Kent's Pond	500
Kenny's Pond	500
South Side Hill Ponds	1,000
George's Pond (Branscomb's Ridge)	1,000
Adam's Pond	1,000
Ponds on Torbay Road	2,000
Quidi Vidi	1,000
Long Pond	40,000

In 1891, 50,000 Rainbow Trout ova were imported and hatched out on May 20th. These were distributed on June 15th to:

Trinity Bay Ponds	10,000
Burton's Pond	2,000
Picco's Pond	3,000
Long Pond River	25,000

These distributions have been in excess of the amount payable to the government for the lease of Long Pond, for which 10,000 fry per annum is paid as rent.

It will thus be seen that the distribution of these fish in open public waters was as follows:

1886—	Lochleven trout	41,000
	White Fish	200,000
	Salmon Trout	270,000
		511,000
1888—	Lochleven Trout	30,000
1889—	Lochleven Trout	15,000
	Hybrids	40,000
		55,000
1890—	California Rainbow trout	10,000
1891—	Rainbow Trout	40,000

That these fish have come to stay has been already proved to demonstration.

14-2-50 (Certified Correct Copy, C. Horley, for Chief Game Warden)

COMMENTS ON VARIOUS BODIES OF WATER SAMPLED

I North Harbour River

Stations 3, 6.

St. Mary's District—flows into North Harbour and then into St. Mary's Bay.
Bottom—rocky to gravel
Vegetation—very scarce
Current—moderate
Depth—maximum of 4 ft.—6 ft.
Surface temperature—9 July 1960—60° F.

This is a favoured stream for angling sea trout and yields good catches by anglers of both types of *Salvelinus fontinalis, Salmo salar, S. trutta* (15″ spec. taken).

Pool-riffle type stream 30—50′ wide.

II Port au Port Bay

Station 9

St. George's Port au Port District—brook and estuary—flowed into Piccadilly Bay then to West Bay then to Port au Port Bay.
Bottom—rocky to sand,
Vegetation—only algae
Shore—gravel to tide flat muck
Water—clear, laminar fresh and salt
Current—moderate
Stream width—20-25 ft.
Depth—maximum of three ft.
Surface temperature—4 July 1960—62° F.

60 ft. seine haul 100 yds. from bay in running water caught *Osmerus mordax, Salvelinus fontinalis, Pseudopleuronectes americanus, Ammodytes americanus, Gasterosteus aculeatus, G. wheatlandi, Apeltes quadracus,* and *Pungitius pungitius.*

One-man seine used in obvious freshwater section of the brook one quarter mile upstream yielded *Fundulus heteroclitus, Gasterosteus aculeatus* and *Apeltes quadracus.*

Water samples taken October 10, 1962, after the tide had been on the rise for 2 hours gave a salinity reading of 19.6 p.p.m. while a sample taken well upstream gave a reading of 5.9 p.p.m.

III Grand Lake
(south end near U.S. Air Force Camp)

Stations 11, 13.

St. George's District—Humber River System
Bottom—very barren, rock and silt
Vegetation—aquatic, scarce to nil
Shore—precipitous and forested
Water—clear, brownish
Temperature series—0830hrs.—16 July 1960—Surface 60° F.

6 ft.		45° F.
12		45°
18		45°
24		42°
30		40°
36		40°
54	bottom	40°

There was a great deal of standing drowned timber around shores; the lake level had been raised 14 ft. by flooding. There was considerable dead timber on bottom near shore. The bottom was fine silt to rocky and very unproductive.

One of the largest and deepest lakes on Island (80 miles long). Steeply sloping precipitous shores, low water temperature, minimum shoal and shore development, apparent low productivity at the south end. No insects seen on bottom.

Gasterosteus aculeatus and small *Salvelinus fontinalis* in tributary brooks. Took *S. fontinalis* and *S. alpinus* only at stream mouths and apparently only successful angling is at stream mouths.

Fish taken in gill net set at 40 ft. depth were caught in the middle of the gang of nets set off the east shore and in 30 ft. of water in net set off a stream mouth on the west shore.

500 yds. of net (1½, 2, 3, 4, 5½ in. mesh) set for two nights yielded five fish—4 *Salvelinus fontinalis* and 1 *S. alpinus.*

IV Lake St. George

Station 14.

Humber-St. George's District—Harry's River, St. George's Bay System.
Bottom—rocky and mud
Vegetation—scarce to nil
Water—clear

Surface Temperature—18 July 1960—66° F.

Temperature series—18 July 1960—Surface 66° F.

6 ft.		63° F.
12		62°
18		62°
24		62°
30		61°
36		55°
42		54°
48	bottom	52°

The west shore had a long, shallow, sloping, rocky shelf with gravel and sandy beach and followed 100 yds. off shore by an abrupt dropoff.

500 yds. of net (1½, 2, 3, 4, 5½ in. mesh) yielded 14 fish (one gang set in two locations for one night each): *Salmo salar* (M), *Salvelinus fontinalis, S. alpinus,* 1 *Anguilla rostrata* seen and there was further evidence of the presence of this species in fish eaten in net, 1 *S. alpinus* taken in 50′, 1 *S. salar* in 15′ of water, 4 *S. fontinalis* (2 chewed by eels) taken in 15′, 4 *S. fontinalis* taken in 30-40′ of water, 4 *S. alpinus* taken in 30-40′ of water.

V Gander Lake

Station 20.

Gander District—Gander River—north shore near pumping station.

Bottom—rocky
Vegetation—nil
Shore—rocky and forested
Water—clear

Set of 250 yds. of net (1½, 2, 3, 4, 5½ in. mesh) overnight in 12—84 ft. of water yielded *Osmerus mordax* (land-locked, very black) in 40-50 ft. of water, *Salvelinus fontinalis* and *S. alpinus* in 18-25 ft. of water.

VI Gambo Lake

Stations 21, 22, 23, 24.

Bonavista North District—Gambo Brook, Freshwater Bay

Bottom—rocky to mud
Vegetation—little aquatic vegetation
Shore—forested and gravel beach
Water—clear, brownish
Depth—30 ft. maximum (in lower Gambo)

Temperature series—25 July 1960—1 mi. above outlet of lower Gambo Lake—Surface 68° F.

6 ft.		66°
12		66°
18		65°
24		65°
30	bottom	60°

The two lakes, upper and lower Gambo, are 20 miles long.

Tributaries Triton Brook and Parson's Brook, inlets of upper Gambo Lake are very important seatrout streams. The "Rattles" or rapids at the Narrows between upper and lower Gambo are favourite angling spots for *Salmo salar.*

In Parson's Brook, which enters the south side of lower Gambo just below the Narrows, *Salmo salar* (parr) and *G. aculeatus* were abundant.

Angling in Oliver's Brook, which enters lower Gambo Lake on the south shore 1 mile below the narrows, yielded 9 sea trout, 28 mud trout in one-half hour from a 30 ft. wide, 4 ft. deep pool.

At mid point of lower Gambo nets caught *Salmo salar* (both types) in 10-25 ft., *Salvelinus fontinalis* in 10 and 25 ft. of water (sea run) and *Osmerus mordax* in 25 ft. of water (head only left in net). 250 yds. of net set overnight half way up lower Gambo Lake on the north shore yielded 18 fish; 250 yds. (1½, 2, 3, 4, 5½ in. mesh) of net set overnight on the south shore 1 mile above outlet yielded no fish.

At Narrows water shallower, rocky mud bottom, warmer (62°F.); moderate heavy vegetation of lily pads and *Vallisneria.* Seines caught *Pungitius pungitius* and *Gasterosteus aculeatus* in shallow shore areas at Narrows.

VII Lake St. John

Stations 25, 27, 30

Fortune Bay-Hermitage District—Lake St. John, Terra Nova System, Bonavista Bay drainage.

Bottom—some rock but mucky
Vegetation—some filamentous algae
Shore—forested
Water—clear, brownish
Depth—maximum 30 ft.
Temperature series—26 July 1960—off the mouth of Ferrier's Brook—Surface 62°F.

6 ft.		60°
12		60°
18		60°
24		60°
30	bottom	60°

Lake St. John or John's Pond is a warm, rather shallow lake with a maximum depth of 30 ft. There appeared to be no thermal stratification.

Tributaries: the Northwest and Southwest rivers and Ferrier's Brook appeared very productive, wide, moderately deep. Some vegetation, such as *Vallisneria,* and rushes. We caught one *Gasterosteus aculeatus* in the Northwest River and saw *Salvelinus fontinalis.*

Below the outlet dams of this lake young of *Salvelinus fontinalis* and *Salmo salar* (landlocked), *Anguilla rostrata* and *Gasterosteus aculeatus* were abundant.

Gill net set overnight off Ferrier's Brook caught 34 fish, 10 trout, 24 landlocked salmon in 12-25 ft. of water (250 yds. net 1½, 2, 3, 4, 5½ in.). Most fish were caught in 15-18 ft. of water but this is probably a mesh-size relationship rather than a depth relationship.

VIII HOGAN'S POND

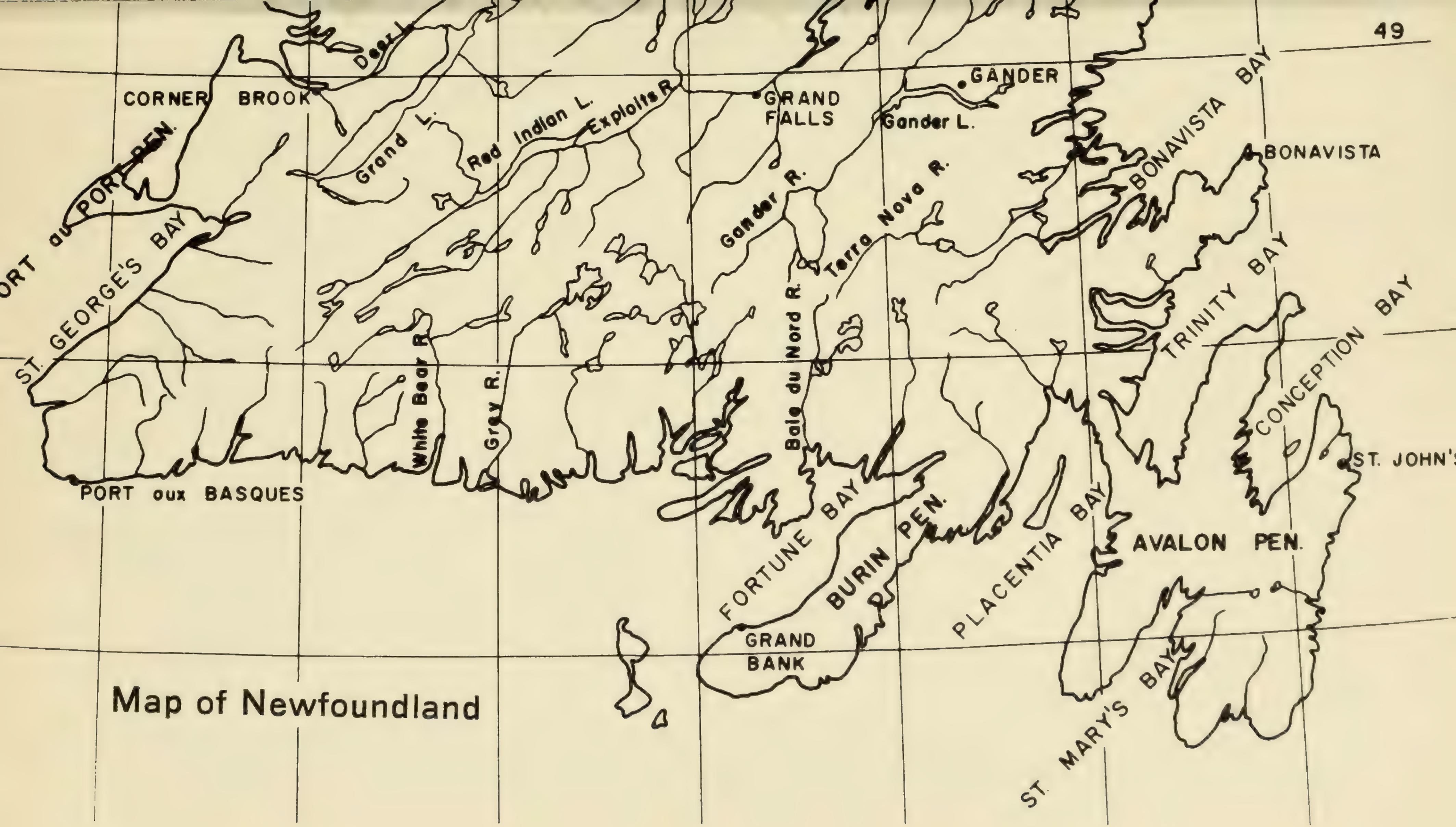
Station 33.

St. John North District—Conception Bay drainage, via Beachy Cove Brook.

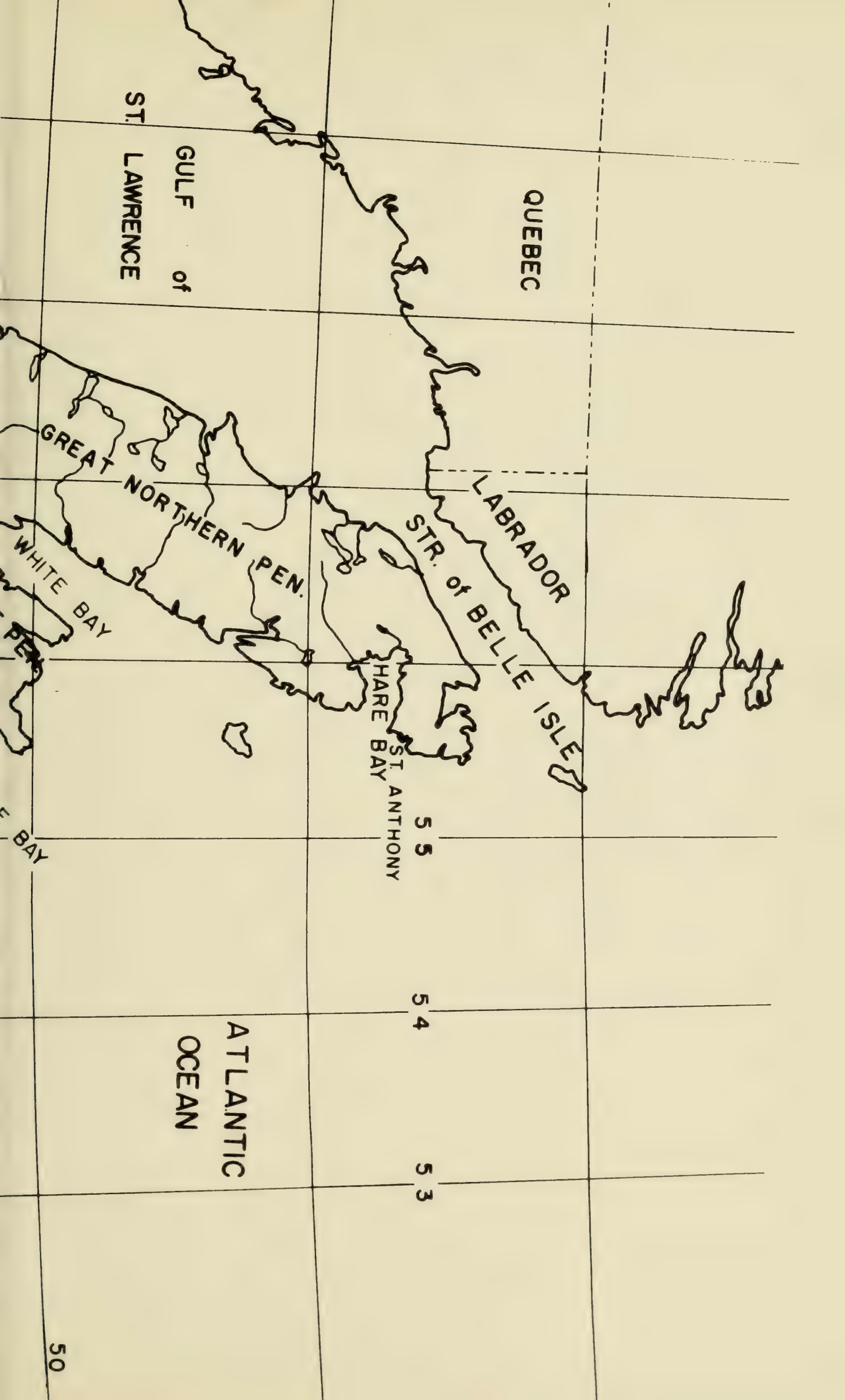
Bottom—rocky, mud
Vegetation—nil
Water—clear, very transparent
Surface temperature—66° F.
Temperature series—29 July 1960—Surface 66° F.

6	ft.	66°
12		66°
18		66°
24		63°
30		63°
36	bottom	63°

Overnight set of 100 yds. 2 in. and 3 in. mesh in 12-24 ft. of water caught 14 *Coregonus clupeaformis* and 2 looked as though they had been eaten by *Anguilla.* This lake has had rainbow trout liberated in it.



Map of Newfoundland


QUEBEC
GULF of
ST. LAWRENCE
LABRADOR
GREAT NORTHERN PEN.
STR. of BELLE ISLE
WHITE BAY
HARE BAY
ST. ANTHONY
55
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